AD-A119 272 HARRY DIAMOND LABS ADELPHI MD F/G 9/1

ELECTRONIC AND MICROELECTRONIC CAPABILITIES.(U)

JUL 82 R H KIGHT, D W MARTIN

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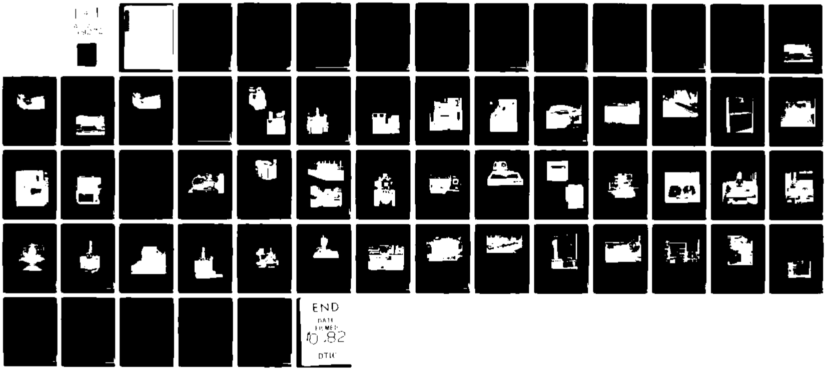

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This brochure outlines the organizational structure and describes the fabrication and support capabilities of the Electronic Engineering Technology Branch of Harry Diamond Laboratories. This branch consists of five primary groups—

Computer-Aided Operations (CAO),
PC Board Facility,
Thick Film Facility,

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20. ABSTRACT (Cont'd)

Assembly/Model Shop, and
Component Testing.

The major equipment pieces associated with each group are described and illustrated to define the range of capabilities of this branch. The descriptions reveal both capability and function.

FOREWORD

The following report describes the capabilities and the equipment that make up the Harry Diamond Laboratories Electronic Engineering Branch. Much of the equipment was purchased under the Production Base Support program. In particular, funding from the FY79 Production Support and Equipment Replacement Program and from FY79 Manufacturing Methods and Technology project 5793960 was used to update and enhance those processes needed to perform the engineering support mission.

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1. INTRODUCTION

The Harry Diamond Laboratories (HDL) Electronic Engineering Technology Branch provides the staff and facilities to support HDL and other Government agencies requiring electronic fabrication. This branch of HDL has extensive knowledge and experience in the production of

- conventional and novel circuit assemblies,
- thick film hybrid microelectronics, and
- printed circuit (PC) boards.

The primary mission of this branch is to support the Army fuze and electronics missions by using advanced assembly and testing procedures to build and evaluate electronic, microelectronic, and electromechanical devices, especially ordnance-related items. This expertise has boosted this branch into the forefront of electronic manufacturing and assembly technology.

The branch can perform the following functions in support of various electronic assembly programs:

- engineering design,
- fabrication planning,
- component testing and evaluation,
- construction of modules, subassemblies, and hybrids,
- assembly of prototype test units, and
- assembly of units for preproduction validation.

Starting from schematics, verbal instructions, or electronic breadboard models, branch personnel

- design, engineer, and plan the fabrication procedures to produce thick film and other prototype hybrid circuits for use in miniaturized and microminiaturized circuit modules, and

- adapt, modify, repackage, and/or construct experimental electronic prototypes for telemetry, proximity, and time-fuze applications, and various other ordnance-related electronics.

In addition to its primary tasks, the branch is also required to remain aware of new developments and advances in existing technology. To accomplish this, the branch performs the following functions:

- It maintains liaison with HDL laboratories, other agencies, and industry to keep abreast of the state of the art in thick film hybrid fabrication methods, microelectronic fabrication and assembly, PC board fabrication, and electronic board assembly methods.

- It provides data, up-to-date references, or other sources of information for laboratory personnel who are concerned with the latest developments in the engineering application of microelectronics and microminiaturized subassemblies.

- It investigates and evaluates novel or state-of-the-art components and techniques for suitability and adaptability to microelectronic ordnance circuitry applications.

- It evaluates and criticizes proposed and existing fabrication methods available to commercial firms and other facilities with regard to small, complex electronic prototype systems that use high-density PC technology.

- It investigates manufacturing method trade-offs in the preparation of HDL team-prepared technical data packages for electronic ordnance systems.

- It provides support to other Government agencies.

Organizationally, the branch is made up of five sections:

- Computer-Aided Operations (CAO),
- PC Board Facility,
- Thick Film Facility,
- Assembly/Model Shop, and
- Component Testing.

The various organizational functions and responsibilities of the sections stem from the operations each performs, as follows.

Computer-Aided Operations

- computer-controlled drafting
- artwork generation
- incoming parts inspection
- wire wrapping
- automatic parts placement
- PC routing
- functional testing and documentation

Printed Circuit Board Facility

- PC pattern design
- artwork preparation
- photographic processing
- PC board drilling and profiling
- PC board fabrication

Thick Film Hybrid Facility

- hybrid design and consultation
- hybrid fabrication
- hybrid packaging
- hybrid sealing

Assembly/Model Shop

- electronic assembly
- custom fabrication
- specialty jobs
- prototype validation
- automated wire wrapping
- encapsulation of modules and subassemblies
- incoming parts inspection
- component testing
- vertical recovery

Component Testing

- component qualification
- component failure analysis
- component test procedures

Personnel and services may overlap and be interchanged between the organizational units with few technological difficulties.

The following description of the area functions and equipment shows in greater detail the operational capabilities of the HDL Electronic Engineering Technology Branch.

2. COMPUTER-AIDED OPERATIONS (CAO)

Tasks performed by this group interact with support functions performed in other groups.

Two interactive computer-terminal work stations (fig. 1) with digitizing tablets allow drawings and schematics to be designed or existing ones modified. The equipment used by this group includes

- one large-scale interactive drawing surface, which is used to perform pen plots up to 4 by 5 ft and to enter drawings into the computer data base;

- a nine-track, 800 bit per inch (BPI) magnetic tape drive, used for archival storage and data transfer to other computer systems;

- a paper-tape reader and punch to produce numerical control (N/C) data for alternative modes of data input and output;

- a 40-million-word moving head disk, used for on-line mass storage;

- a CV 150 photoplotter (fig. 2) to provide photographic output for computer-designed circuits with 0.001-in. accuracy over a 24 by 24 in. area.

Using recently acquired software, the computer-aided design system can perform automatic routing and automatic component placement for complex PC boards.

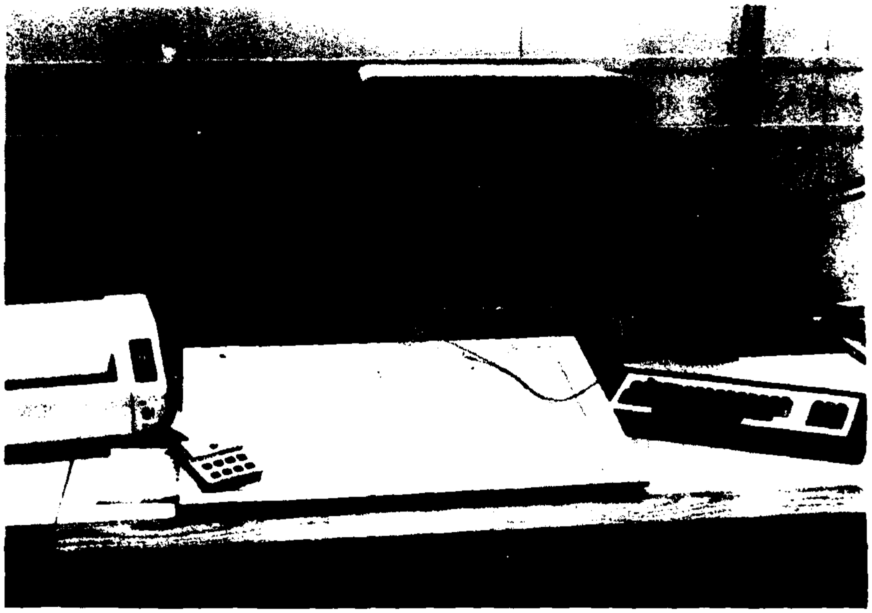

Figure 1. Computer-terminal work station.

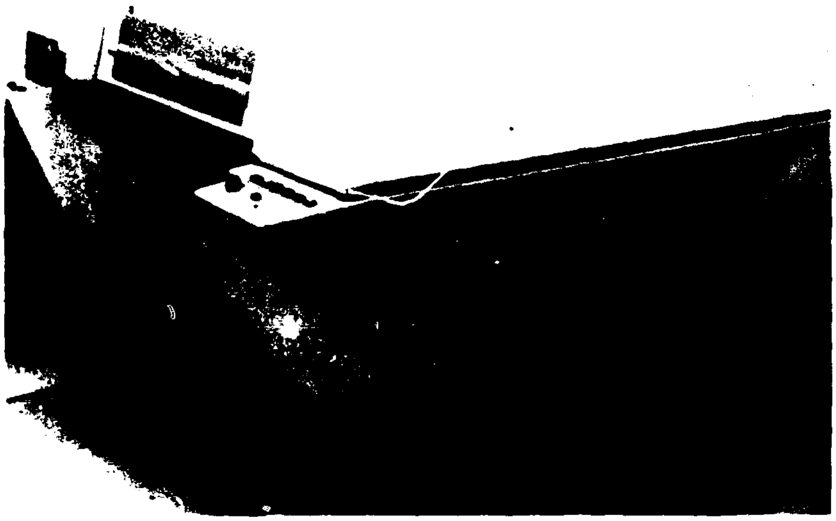

Figure 2. CV 150 photoplotter.

3. PRINTED CIRCUIT BOARD FACILITY

A complete modern PC facility supports HDL R&D electronics requirements. PC boards have the advantages of low production costs, the ruggedness required to withstand severe ordnance environments, and the technology ideally suited to the small sizes and volumes needed in electronic fuzing applications.

The initial PC board layouts, artwork, and N/C drill tapes can all originate in the CAO area. However, each of these functions can also be done in the PC board area itself.

After a PC board is designed, the layout is transferred to a "strip and peel" master or a taped master which is then photoreduced to the proper scale. If necessary, one can "step and repeat" the scaled artwork to obtain multiple images for large production runs.

The photographic etching process uses a "photo tool" (negative or positive) to expose a cleaned, photosensitized (photoresist) copper-clad board to a timed ultraviolet source. Areas of unexposed photoresist are washed away, leaving

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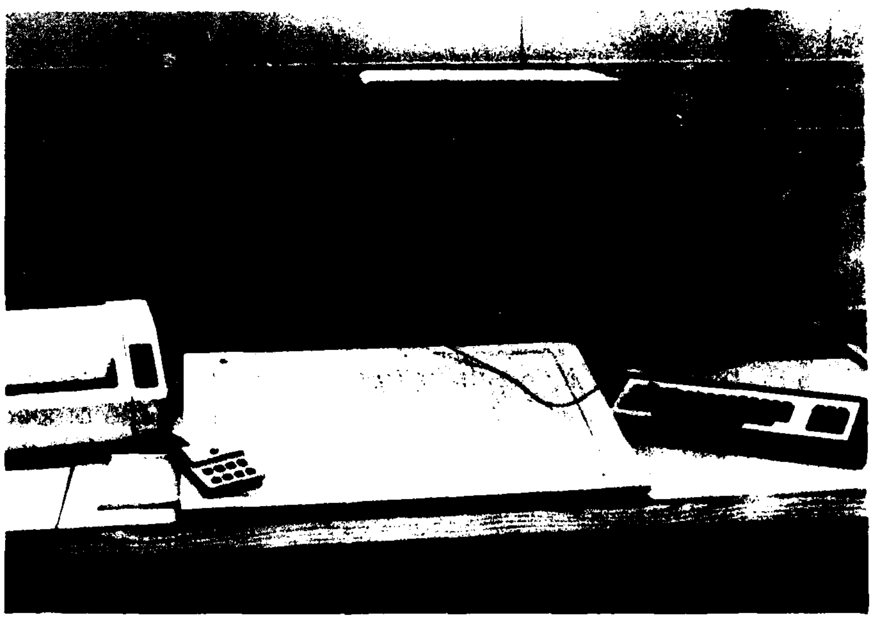

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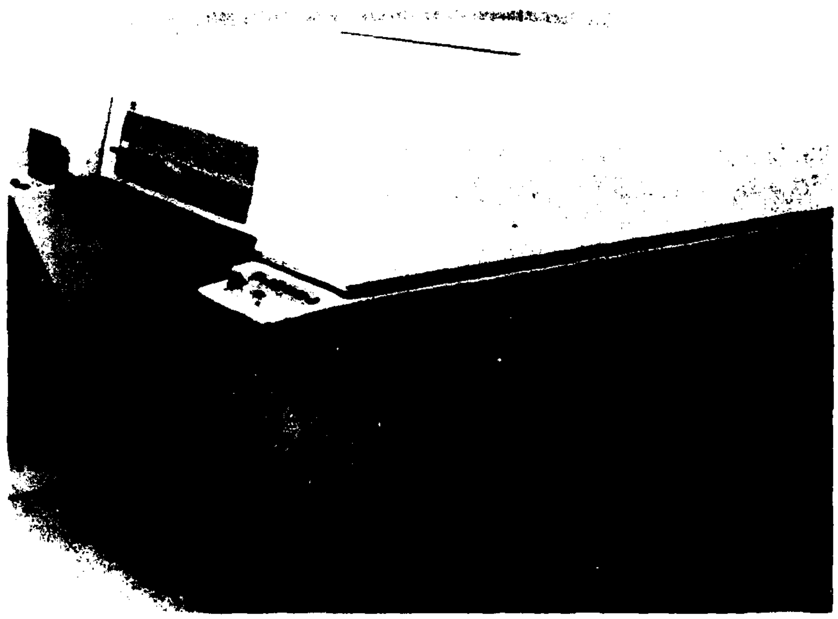

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bare copper to be etched away. The remaining copper pattern is ready for cleaning, drilling, profiling, and component assembly. Several variations of this process are used to prepare single- and double-sided boards, as well as plated through-hole circuit boards. In addition to the photographic equipment, this facility also contains a "wet-chemistry" section that performs

- electroless copper depositions,
- copper electroplating,
- tin-lead electroplating,
- photoresist deposition,
- photoresist processing, and
- copper-etch baths.

The following sections describes some of the equipment used to perform PC manufacturing.

3.1 *Borrowdale Pioneer Precision Photo-Reduction Camera*

The Borrowdale camera (fig. 3) is used to reduce master artwork. The copy board can accommodate 39 by 39 in. masters, which are then reduced to 11 by 14 in. negatives. Three low-distortion Gertz lenses and one ultramicron Nikon lens give the Borrowdale camera a single-step reduction range from 1:1 to 25:1. The camera back contains a pinned film plane and a manual step-and-repeat capability with negative control to 0.0001 in. The object light source makes use of a filtered, back-lit, monochromatic system.

3.2 *HLC Polykon Automatic Step and Repeat Camera*

The HLC camera (fig. 4) is used to generate multiple images from a single master. This system makes use of a master image with 1:1 ratio on 5 by 7 in. film. The system automatically steps and repeats the master image up to 999 times in both axes over a final film area of 16 by 20 in. The step resolution is 0.001 in., with repeatability to 0.0005 in. This system allows the PC facility to manufacture low-cost multiples of an item.

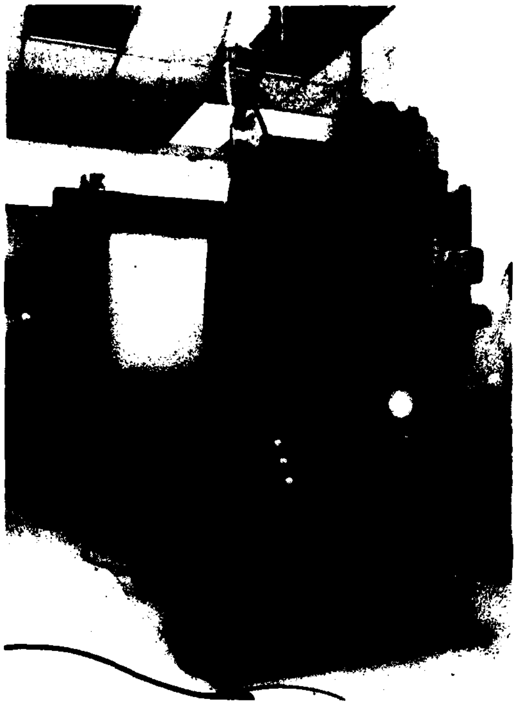


Figure 3. Borrowdale Pioneer Precision Photo-Reduction Camera.

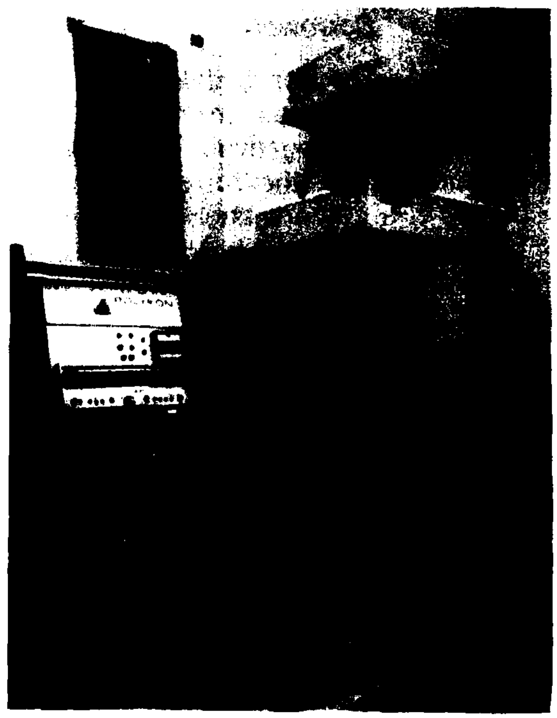


Figure 4. HLC Polykon Automatic Step and Repeat Camera.

3.3 *Precision Industries 747 Tooling Hole Drill and Pin Machine*

The Precision Industries 747 (fig. 5) is a two-drill head unit which can drill tooling holes spaced from 5 to 30.0 in. apart, with a repeatability of 0.001 in. Circuit boards with a combined thickness of up to 5/8 in. can be drilled and pinned.

After the circuit board stack is placed into the machine, a clamp locks the stack, and the air-driven self-feeding drills advance and machine two tooling holes. The drill spindles retract automatically and two hardened steel pins are pressed into the drilled holes. The pinned boards are released, and the board stack can be removed and mounted on the N/C drilling machine.

This machine provides a repeatable process to manufacture PC boards in large-quantity lots.

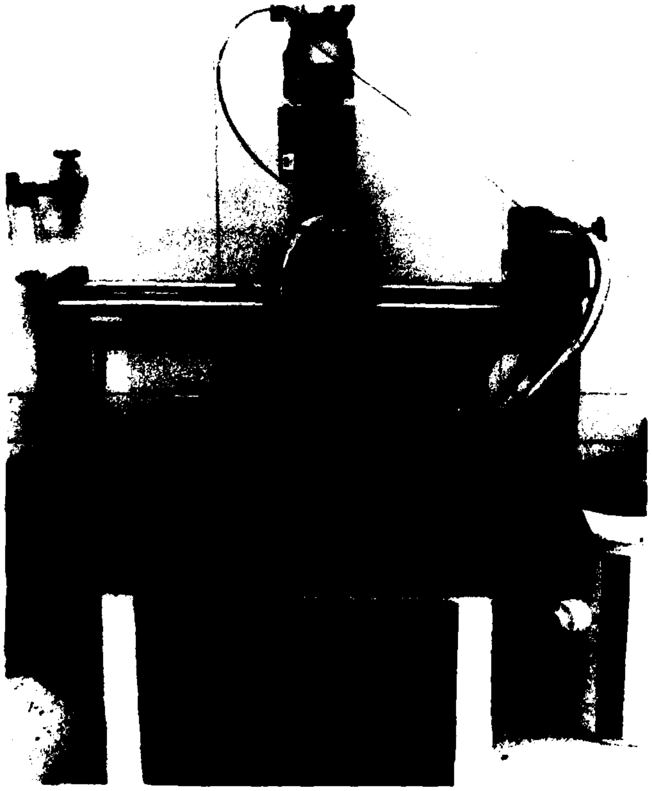


Figure 5. Precision Industries 747 Tooling Hole Drill and Pin Machine.

3.4 *Excellon XL-3D/R PC Board Driller/Router*

The Excellon XL-3D/R is a multispindle PC board drilling and pinless routing machine (fig.6). It has three liquid-cooled 1-hp brushless ac induction spindle motors that rotate between 15,000 and 65,000 rpm, with a feed rate that is variable from 10 to 200 in./min and a linearity of ±5 percent. The depth control repeatability is ±0.015 in. The table positioning accuracy is ±0.0005 in., and its repeatability is ±0.0005 in. Pattern accuracy under the work area of each spindle is ±0.001 in., and the routed board accuracy is ±0.002 in.

Drill or route data can be input to the machine either by N/C paper tape or by manual keyboard. Tape preparation is performed with the on-board programmer.

Automatic tool changing can be programmed for 9 tools, each with a hit rate of up to 400/min when drilling and a feed rate of 200 in./min when routing. Maximum panel size is 24 by 24 in. for the center spindle and 18 by 24 in. for each outside spindle.

This driller/router provides a high-speed, close-tolerance machining capability for the PC facility.

Figure 6. Excellon XL-3D/R PC Board Driller/Router.

3.5 *DuPont Riston LC-2400 Laminator and Cleaner*

The Riston LC-2400 (fig. 7) performs a two-step process to prepare copper PC materials for processing. The cleaner removes dust and other particulate matter that contaminates both sides of the panel just before lamination. Temperature-controlled internally heated laminating rools apply resist to both sides of the cleaned substrate at a feed rate determined by material type and thickness. This allows high-yield production of complex boards.

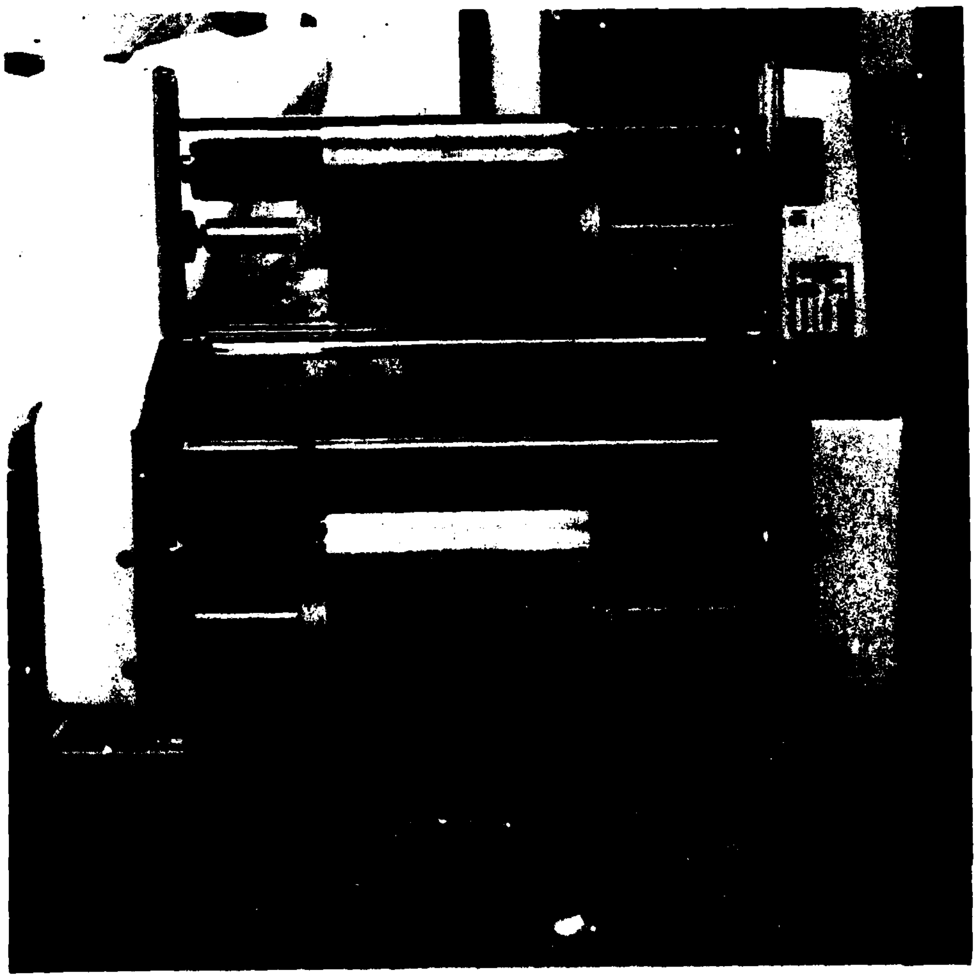


Figure 7. DuPont Riston LC-2400 Laminator and Cleaner.

3.6 *Colight System V Ultraviolet Exposure Source*

The Colight exposure source (fig. 8) is a dual vacuum-tray upright-exposure machine providing simultaneous double-sided exposure for PC board fabrication. This machine uses two separate medium-pressure mercury-discharge lamps that have dual power output and are independently controlled in light intensity by either a thumbwheel timer or a sophisticated light integrator. The maximum exposure size is 24 by 24 in. A PC board line/space resolution of 0.004 in. can be exposed, with a ±5 percent repeatability.

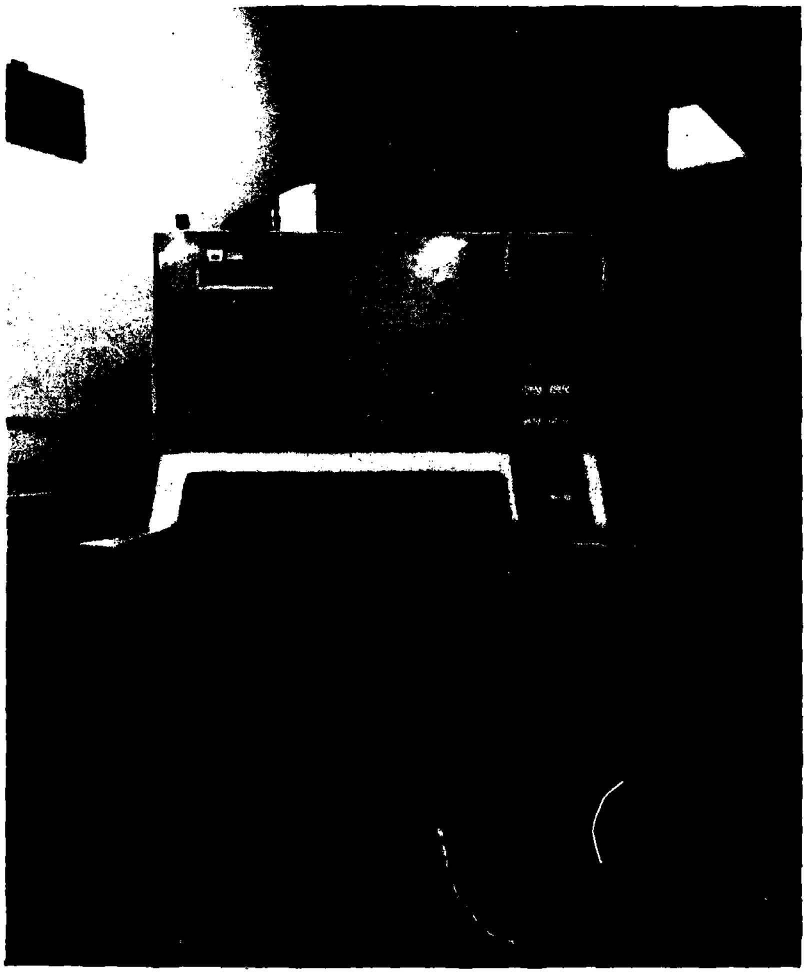


Figure 8. Colight System V Ultraviolet Exposure Source.

3.7 *Colight CV-224 Etcher*

The Colight etcher (fig. 9) is used during the manufacture of PC boards to remove unwanted copper from the surface of the boards. It has an effective etching width of 24 in. and can handle almost any length. The sump holds approximately 70 gallons of etchant to supply 160 nozzles. To transport the PC board material, the etcher uses a conveyor with adjustable speed from 0 to 10 ft/min. After the board passes through the etch chamber, the final rinse chamber removes excess etchant with wet-air knives to minimize water usage.

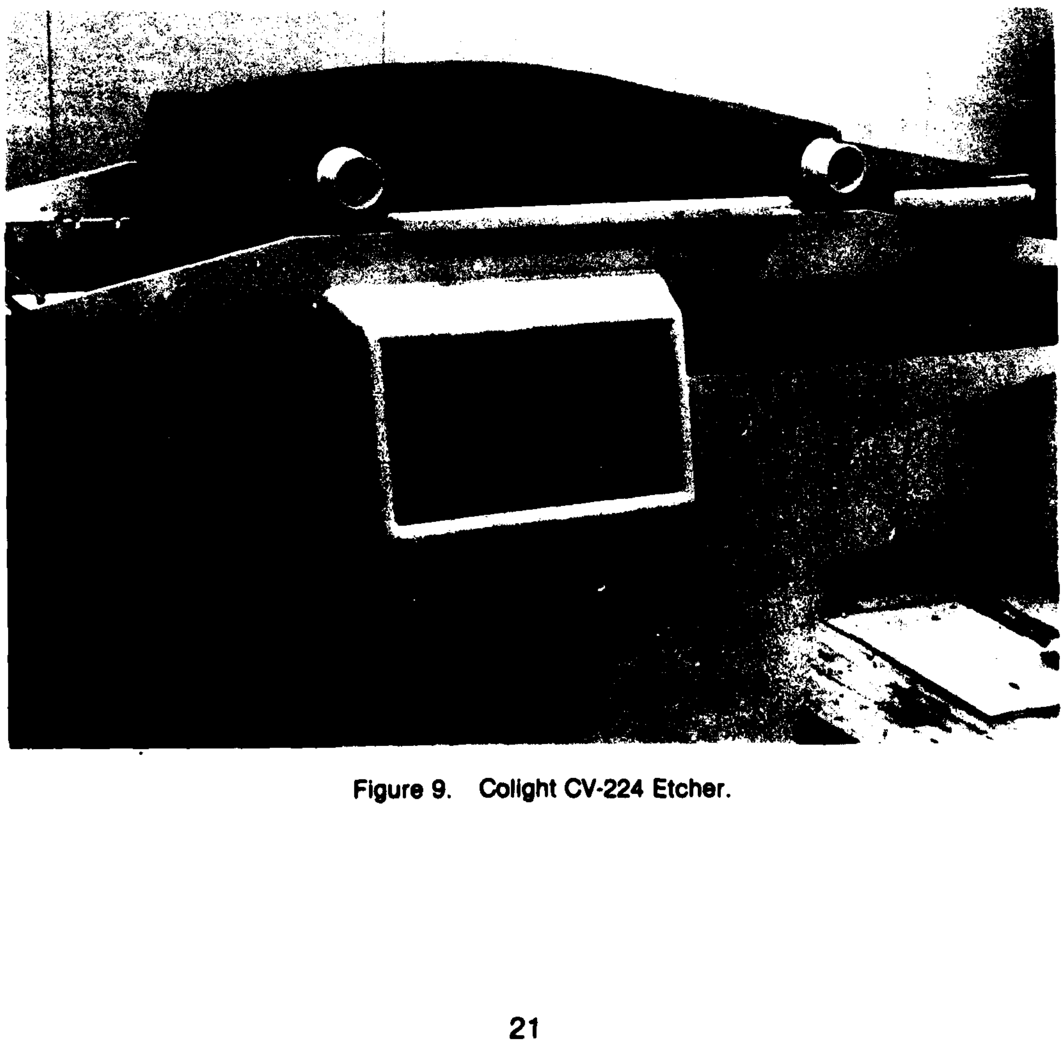


Figure 9. Colight CV-224 Etcher.

3.8 *Colight Vertical Rotary Etcher*

For specialized applications requiring controlled etching, the PC facility uses a vertical rotary etcher (fig. 10). This etcher uses an eccentric board rotation with a perpendicular spray to control etching. This movement, combined with overlapping spray and fixed sprayheads, allows the machine to etch 0.001-in. lines with 0.001-in. spaces on 1-oz. copper. The maximum rotary work size is 18 by 18 in.

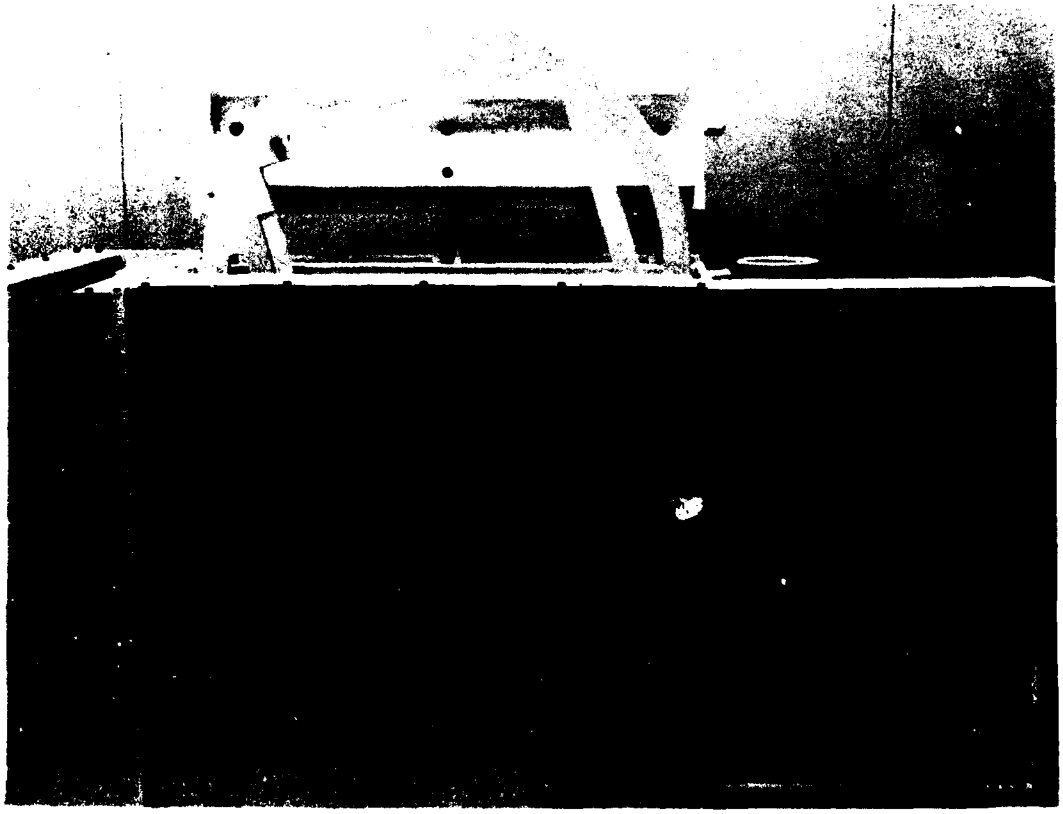


Figure 10. Colight Vertical Rotary Etcher.

3.9 *Aztec Products Custom Wet-Chemistry Line*

During the manufacture of PC boards, it is necessary to go through a series of cleaning, plating, and etching steps. The HDL wet-chemistry line (fig. 11) provides the capability to fabricate single-sided, double-sided, and plated

through-hole boards. Copper and tin-lead solder plating and chemical milling are other capabilities in this area.

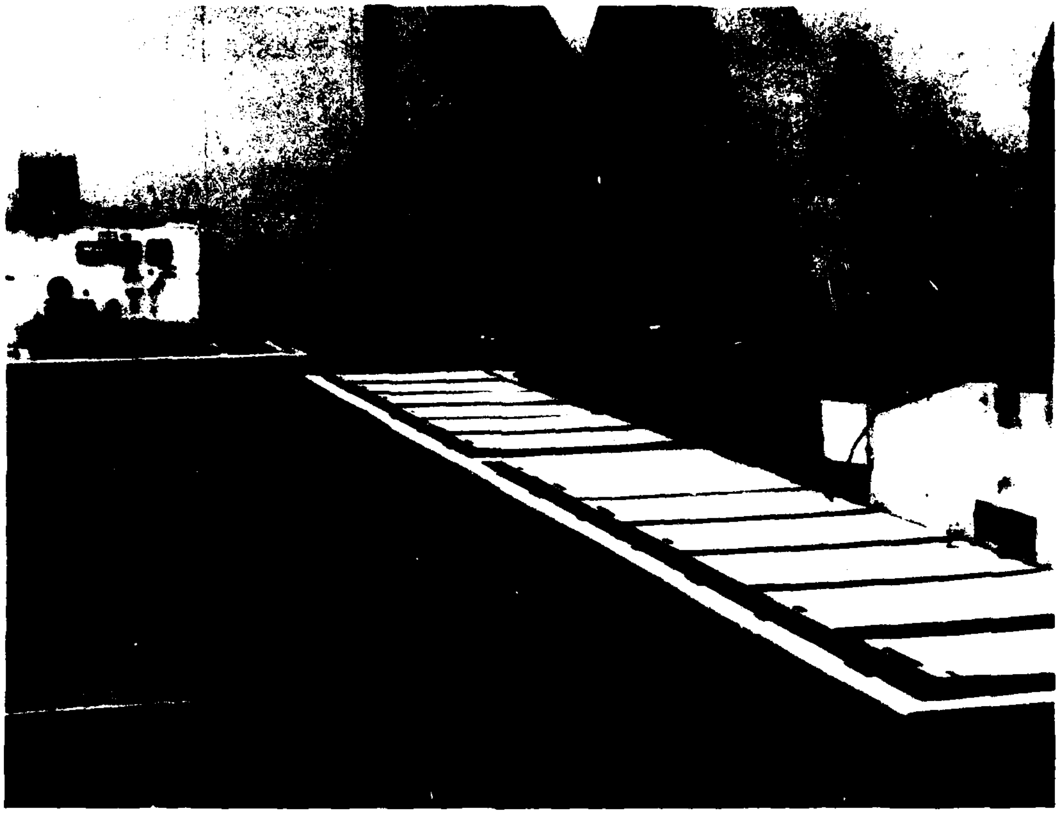


Figure 11. Aztec Products Custom Wet-Chemistry Line.

3.10 *Kollmorgen Corporation, Photocircuits Division, CC4 Additive Module*

Photocircuits' additive process is a method that selectively plates copper onto unusual circuit board shapes. The CC4 module (fig. 12) consists of two units: the activation tanks and the plating tanks. The activation tanks contain chemicals that prepare the precatalyzed and adhesive-coated laminate surface for deposition of the electroless copper by creating active sites in the adhesive which chemically and mechanically bond the laminate.

The plating tanks consist of a replenishable premixed electroless copper bath and a rinse section. The copper bath used for plating fully additive cir-

cuitry can be maintained without the necessity for repeated or automatic analysis. The replenishment additions are made empirically, based on a known platable area, by means of an addition pump and timer.

The bath will deposit 0.0013 in. of copper in about 16 hours.

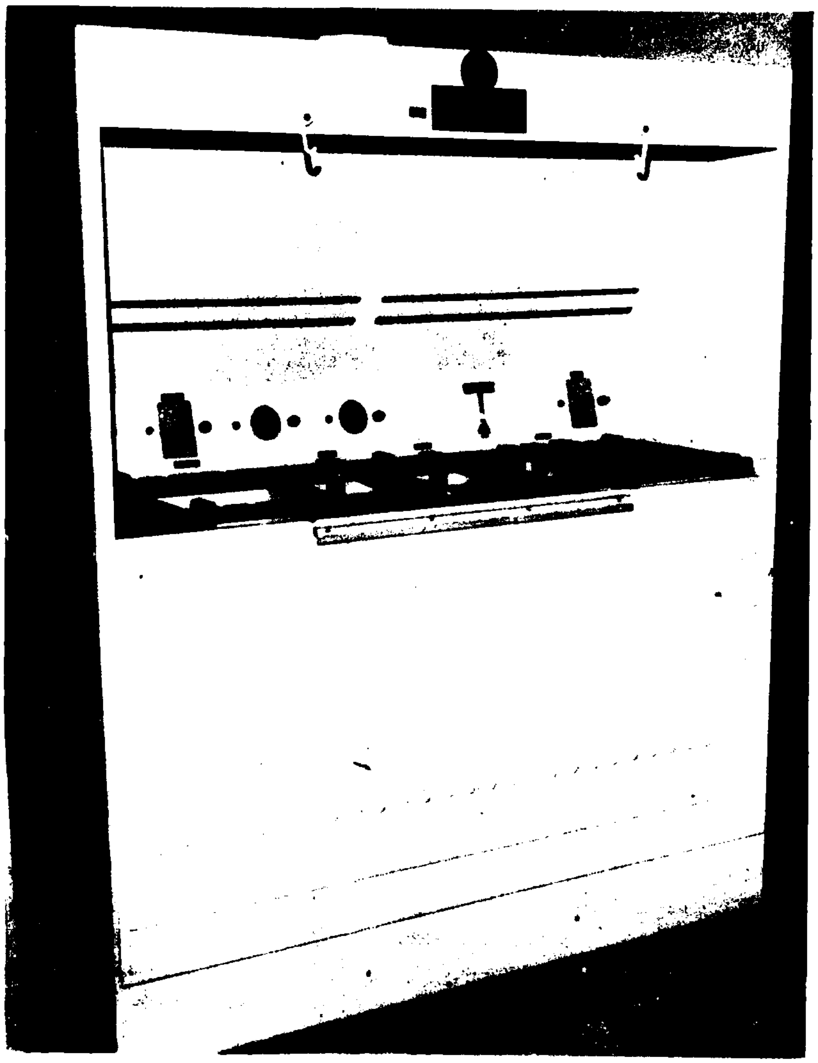


Figure 12. Kollmorgen Corporation, Photocircuits Division, CC4 Additive Module.

3.11 *Wabash Multilayer Programmable Laminating Press*

The Wabash press (fig. 13) is a hydraulically operated, electrically heated, water-cooled, double-platen multilayer press with a maximum capacity of 50 tons. It is primarily used for the fabrication of multilayer PC boards. This press has a platen work size of 18 by 18 in.

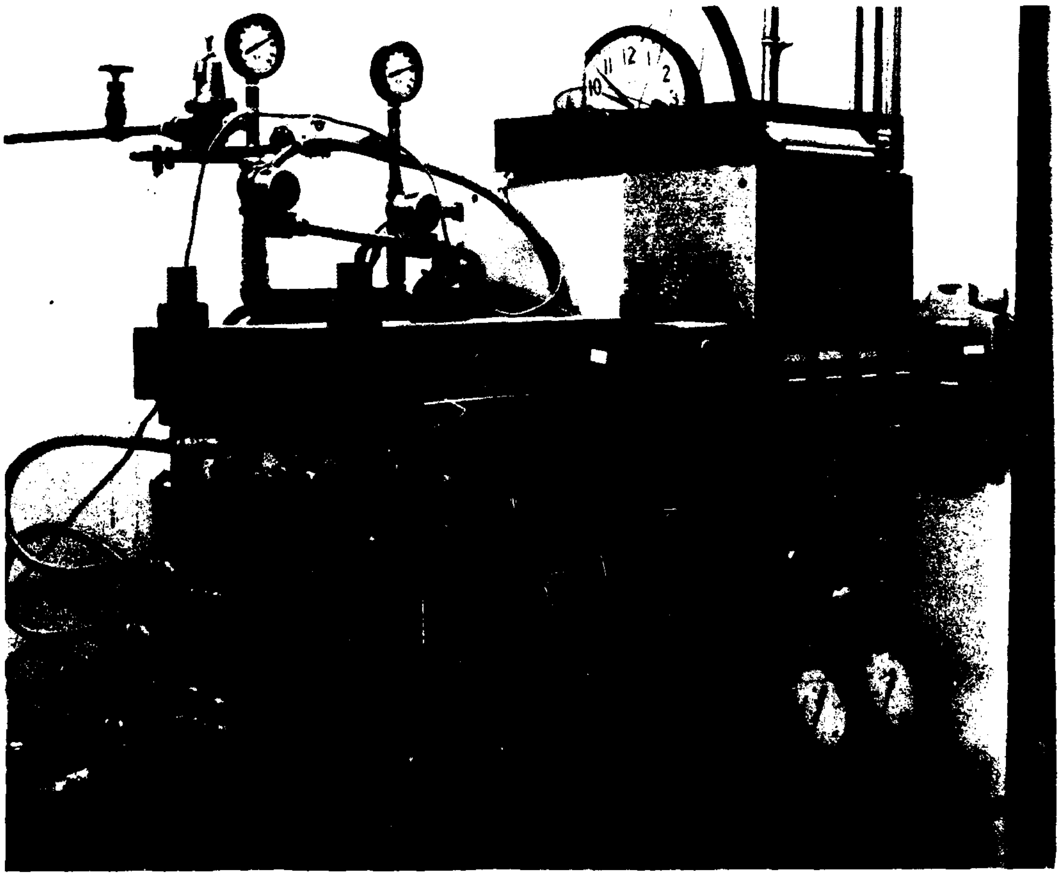


Figure 13. Wabash Multilayer Programmable Laminating Press.

3.12 *Electrovert Automatic Solder-Coating and Hot-Air Leveling Machine*

The function of the Electrovert solder-coating machine (fig. 14) is to automatically solder-coat copper circuitry on PC boards and to clean all holes of

solder. The process functions in an adjustable and controlled manner without degrading or stressing the PC board. This is all achieved with minimal manual touch-up.

This machine will process PC boards up to 18 by 24 in. with thicknesses from 0.031 to 0.125 in.

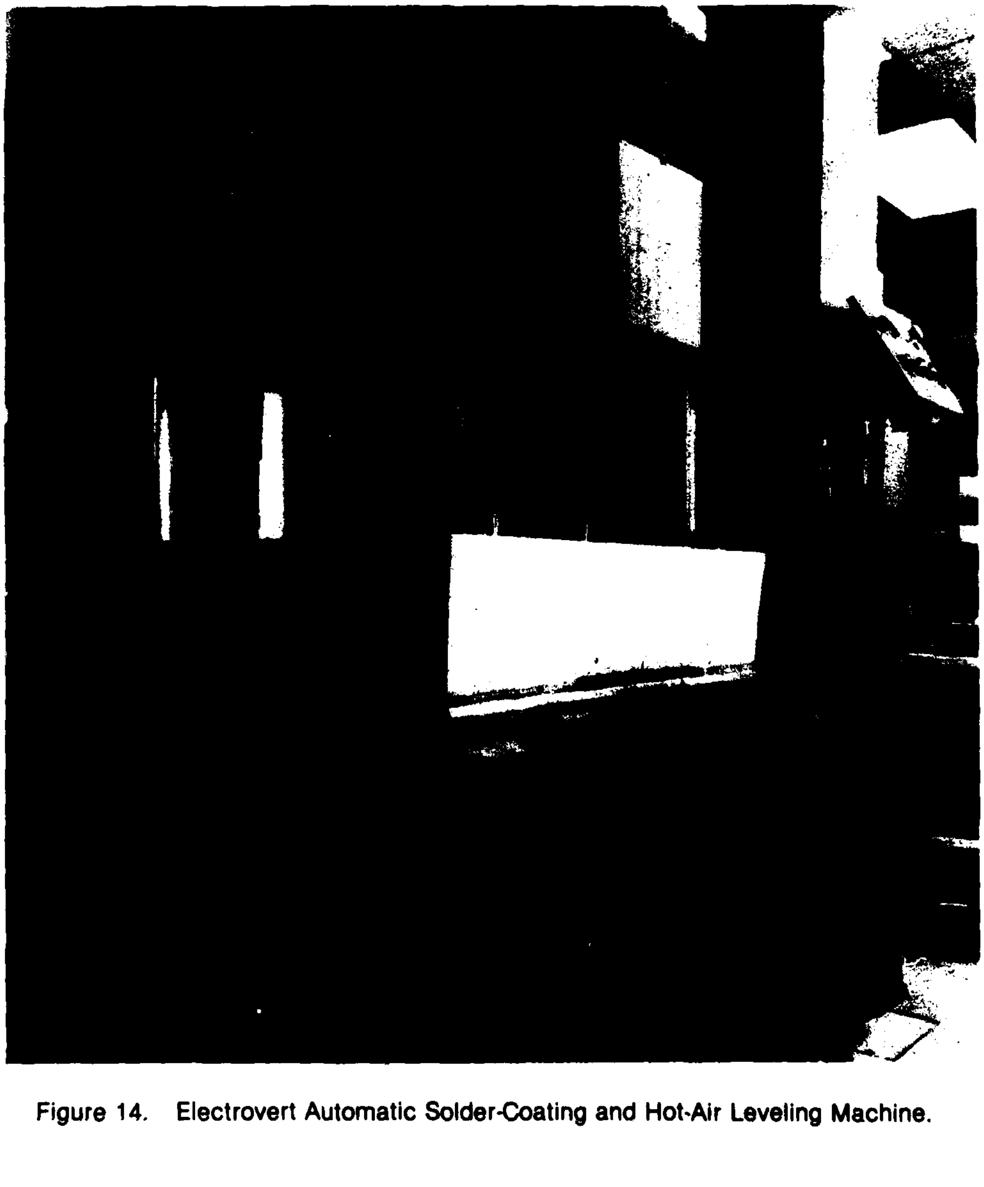


Figure 14. Electrovert Automatic Solder-Coating and Hot-Air Leveling Machine.

3.13 *Unique Industries, Inc., Ultrasonic Cleaner*

The Unique Industries Vapo-Kleen (fig. 15) is a heavy-duty ultrasonic vapor degreaser used for a combination of immersion, spray, ultrasonic rinsing, and vapor cleaning. It is used with chlorinated, fluorinated, or blended solvents.

The ultrasonics are powered by solid-state generators. The generators feature automatic tuning circuitry to compensate for fluctuating work loads and liquid levels; this circuitry also controls fluid "wave speed" to prevent inactive zones. The cleaning basket is 16 by 12 in.

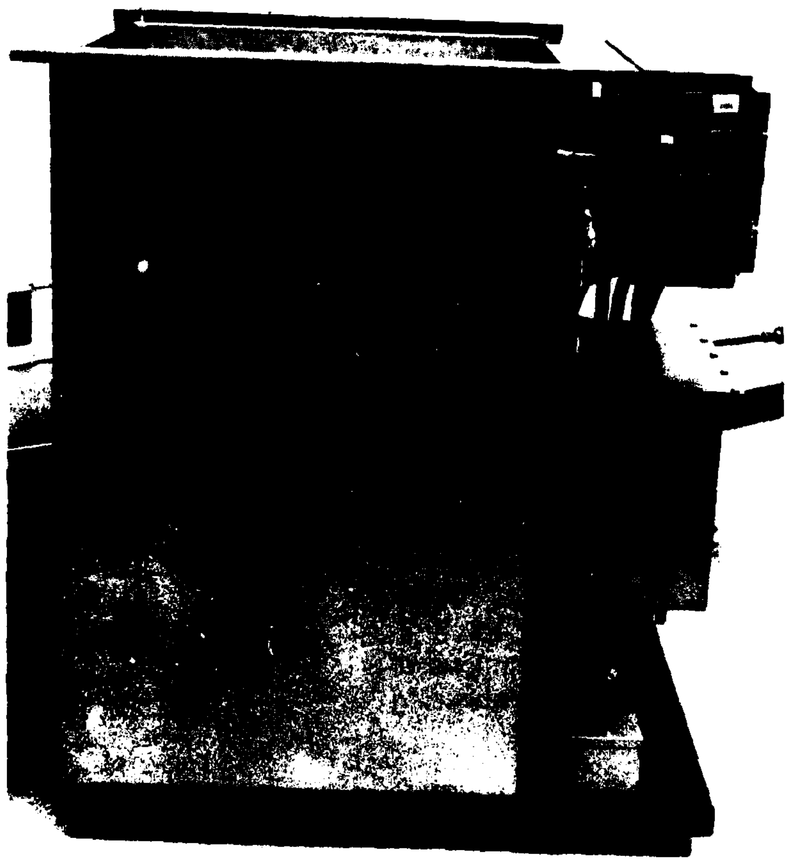


Figure 15. Unique Industries, Inc., Ultrasonic Cleaner.

4. THICK FILM FACILITY

The thick film fabrication group provides a complete design and manufacturing capability for a wide variety of complex, thick film components and circuits. The group can produce or process

- conductors,
- resistors,
- capacitors,
- inductors, and
- crossover and multilayer dielectrics.

The thick film facility offers an alternative to PC boards, especially for those electronic designs limited in packaging volume. Thick film processes make use of an insulating substrate onto which various materials are processed to form conductors, resistors, capacitors, inductors, and other structures required to fabricate microelectronic hybrids. The thick film fabrication process uses a closely monitored step-by-step procedure illustrated in figure 16. Descriptions of various pieces of hybrid processing equipment follow.

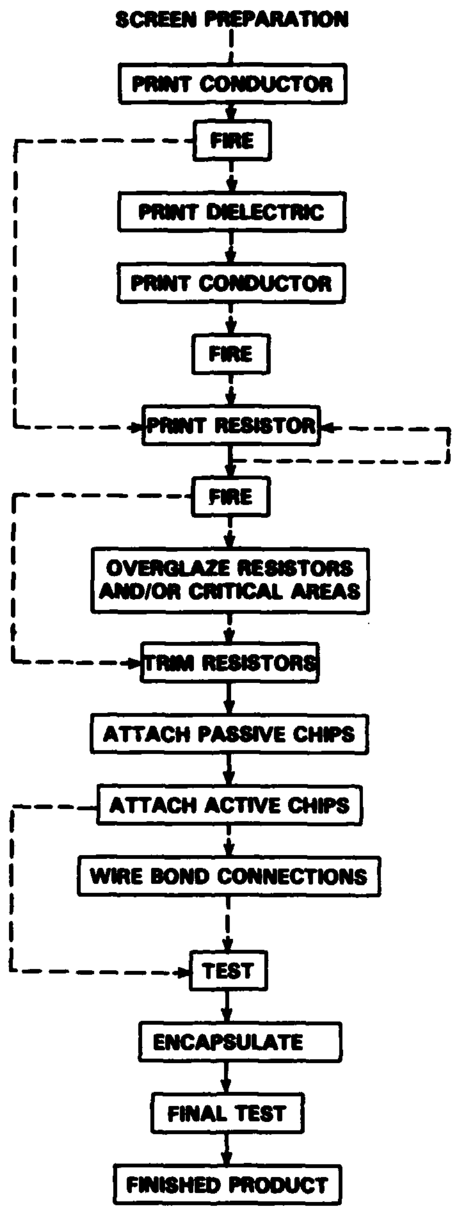


Figure 16. Thick film fabrication flowchart.

4.1 *Presco Model 332 Printer*

The Presco precision manual screen printer (fig. 17) is used for printing conductor, resistor, dielectric inks, and solder paste in the production of thick film hybrids. With screen sizes of 5 by 5 in. and 5 by 7 in., the size and shape of substrates using different platens can range from as small as 0.5 in. round to 2 by 2 in. square; odd (trapezoidal) shapes can also be accommodated. This screen printer is used for small-quantity thick film prototypes and for the evaluaton of thick film materials.

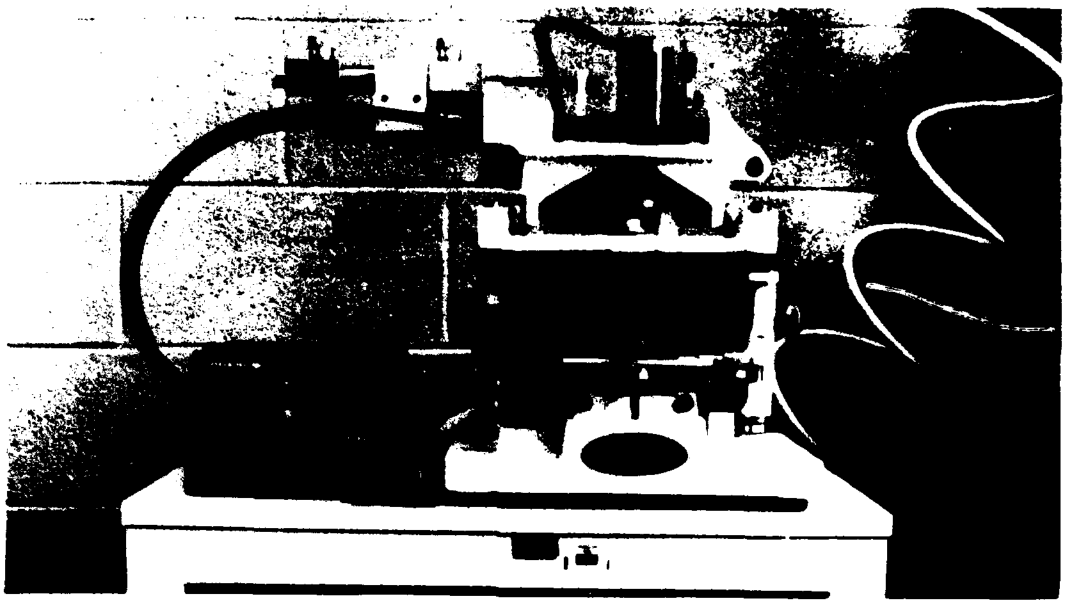


Figure 17. Presco Model 332 Printer.

4.2 *Presco Model CP-645 Semiautomatic Printers*

Two Presco thick film printers (fig. 18) are used for continuous, high-speed semiautomatic screen printing of substrates as large as 3 by 4 in. These production-grade printers can accommodate screen sizes from 5 by 5 in. to 8 by 10 in. During high-speed operation, they have a repeatable carriage accuracy of ±0.0005 in. and can screen print 1200 substrates per hour. These printers are used to validate hybrid technical data packages before production.

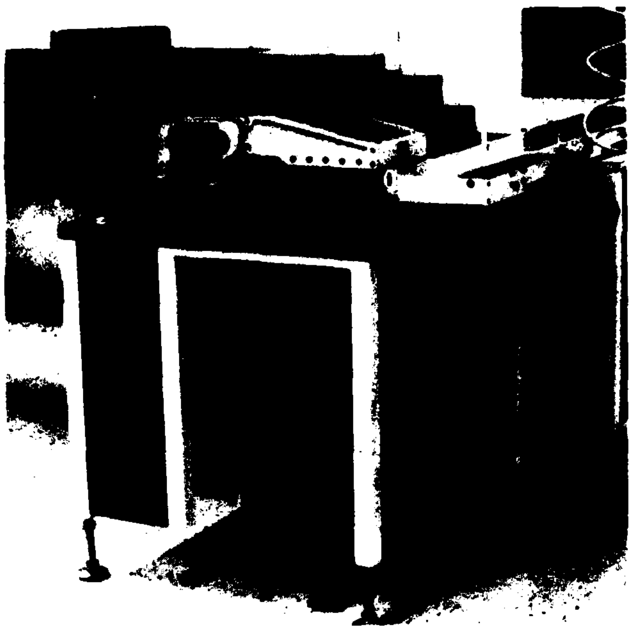


Figure 18. Presco Model CP-645 Semiautomatic Printers.

4.3 *BTU Engineering Furnaces*

Two BTU furnaces (fig. 19) are used to fire printed conductor, resistor, and dielectric materials in a preprogrammed temperature profile. Each furnace features a six-zone conveyorized oven with an adjustable temperature range of 200° to 1250° C per zone. The belt speed and air flow are also adjustable. The time-temperature profile is repeatable within 2° C.

4.4 *ESI Laser Trimmer System*

Resistors fabricated under the thick film process often require trimming to bring the fired value into tolerance. The trimming is performed by a laser. The ESI laser trimming system (fig. 20) consists of an enclosed laser, a laser power supply, and a laser control system. Together, these components provide a high-speed capability to perform active or passive resistor trimming to tolerances less than ±1 percent.

Figure 19. BTU Engineering Furnaces.

Figure 20. ESI Laser Trimmer System.

4.5 *Bausch and Lomb Metallurgical Microscope*

The Bausch and Lomb triocular head microscope (fig. 21), with circular and orthogonal mechanical stages, and bright and dark fields, is used for inspection of alloys, silicon wafers, ceramics, and hybrid circuits. This microscope can magnify from 50 to 400 times and has filter-controlled image contrasting. The microscope is also used to optimize laser-trimming parameters to avoid hot spots during high-speed resistor trimming.

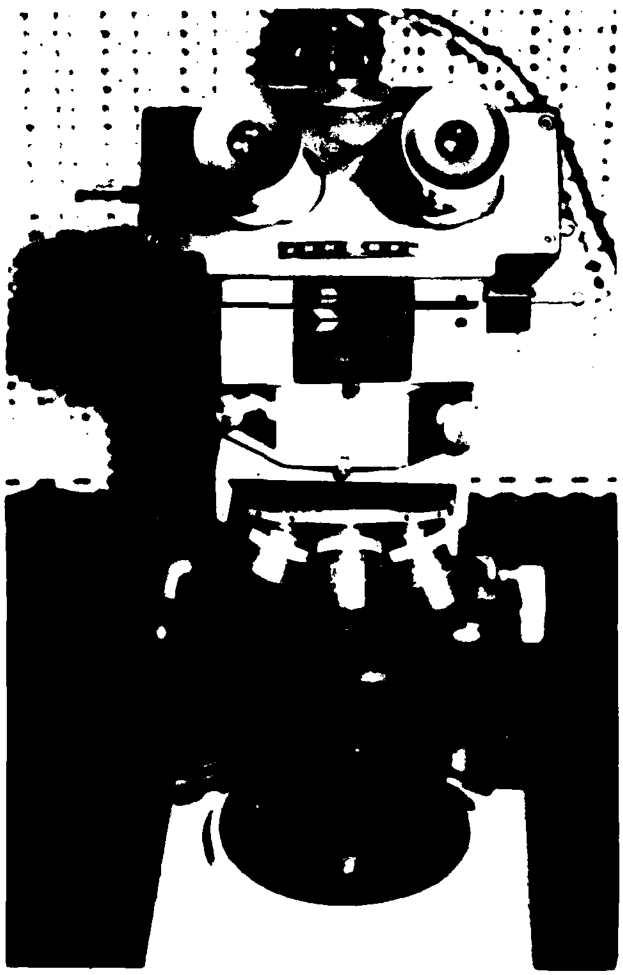


Figure 21. Bausch and Lomb Metallurgical Microscope.

4.6 *Excellon Micronetics MC-20 Chip Assembly System*

During the thick film hybrid assembly process, passive chip components must often be placed onto the hybrid substrate. An automatic placement system facilitates this process, allowing fast, repeatable component placement. The MC-20 system (fig. 22) places chip capacitors, chip resistors, and chip carriers onto hybrid electronic circuits. If needed, paste solder or epoxy can be applied. The placement rate is 800 chips per hour. The assembly system uses an electronic memory to store placement instructions for on-line operation; these instructions can be transferred to a cassette storage device for future use.

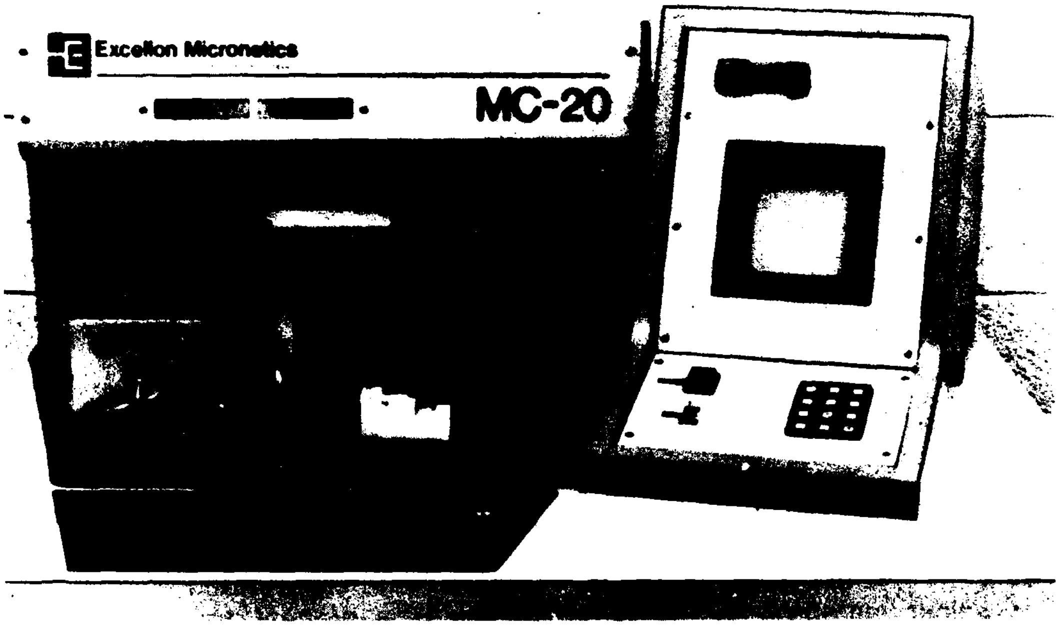


Figure 22. Excellon Micronetics MC-20 Chip Assembly System.

4.7 *Browne Rotary Reflow Soldering System*

The Browne rotary system (fig. 23) is used for high-speed prototype and production soldering of ceramic hybrid circuits, as well as for repair and engineering changes of components as needed. The time on each stage (preheating, heating to reflow, and cooling) is 11 to 22 s for most substrates.

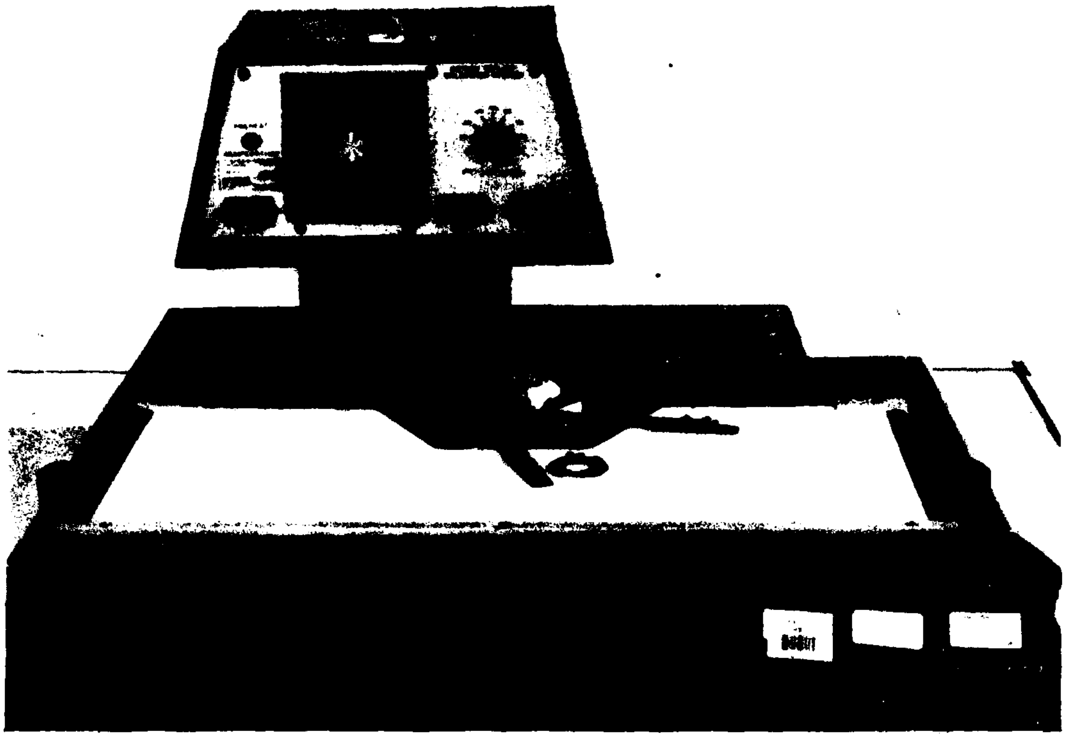


Figure 23. Browne Rotary Reflow Soldering System.

4.8 *Argus Infrared Oven*

The Argus oven (fig. 24) uses controlled infrared energies to reflow solder materials on hybrid assemblies. The preheat zone gently heats the substrate to minimize thermal shock and to maximize flux actions. The short high-energy zone reflows the solder without excessive heating. The time-temperature profile can be controlled to within 2 percent. The solder solidifies in the cooling zone, so at the end of the belt the substrate may be handled by the operator.

4.9 *Branson Ultrasonic Degreaser Model B-250*

The Branson degreaser (fig. 25) is a compact, self-contained cleaning system. The system consists of a control panel, boiling sump, ultrasonic sump, and refrigeration system. The degreaser is used to remove solder flux and to clean hybrids.

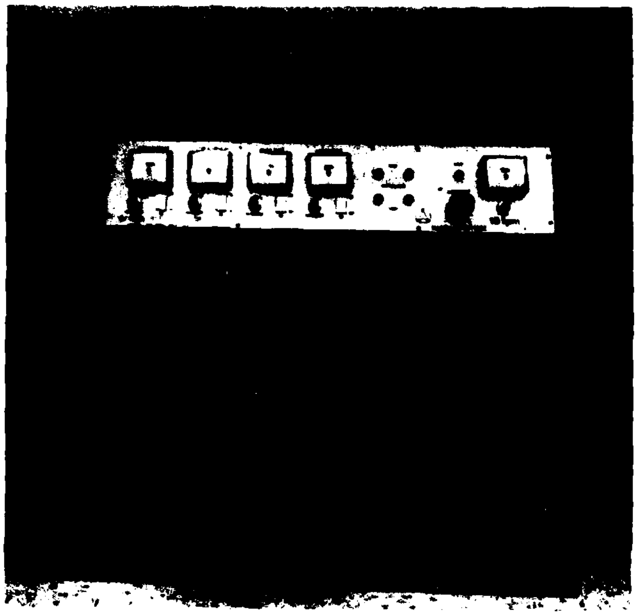
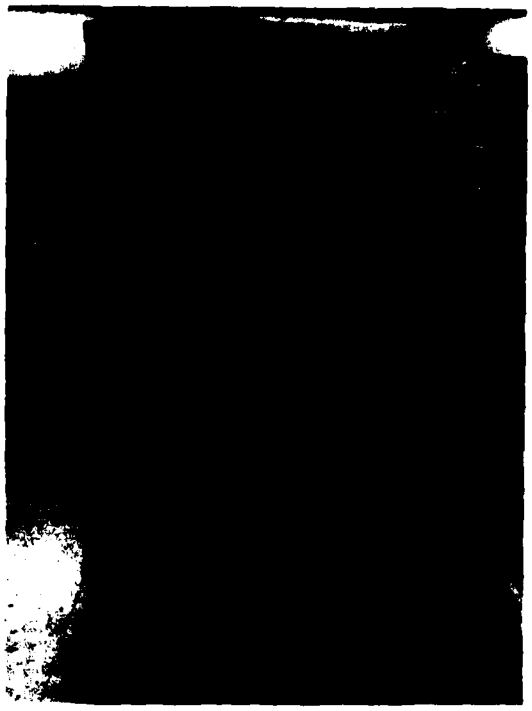


Figure 24. Argus Infrared Oven.

Figure 25. Branson Ultrasonic Degreaser Model B-250.



4.10 *MEC Semiautomatic Die Bonder*

The MEC die bonder (fig. 26) makes eutectic bonds, epoxy bonds, and glass/eutectic bonds between semiconductor dies and virtually any package style. This bonder features precise automatic die pickup, placement, and lead-frame extraction after bonding. Bond time can be as short as 1 s.

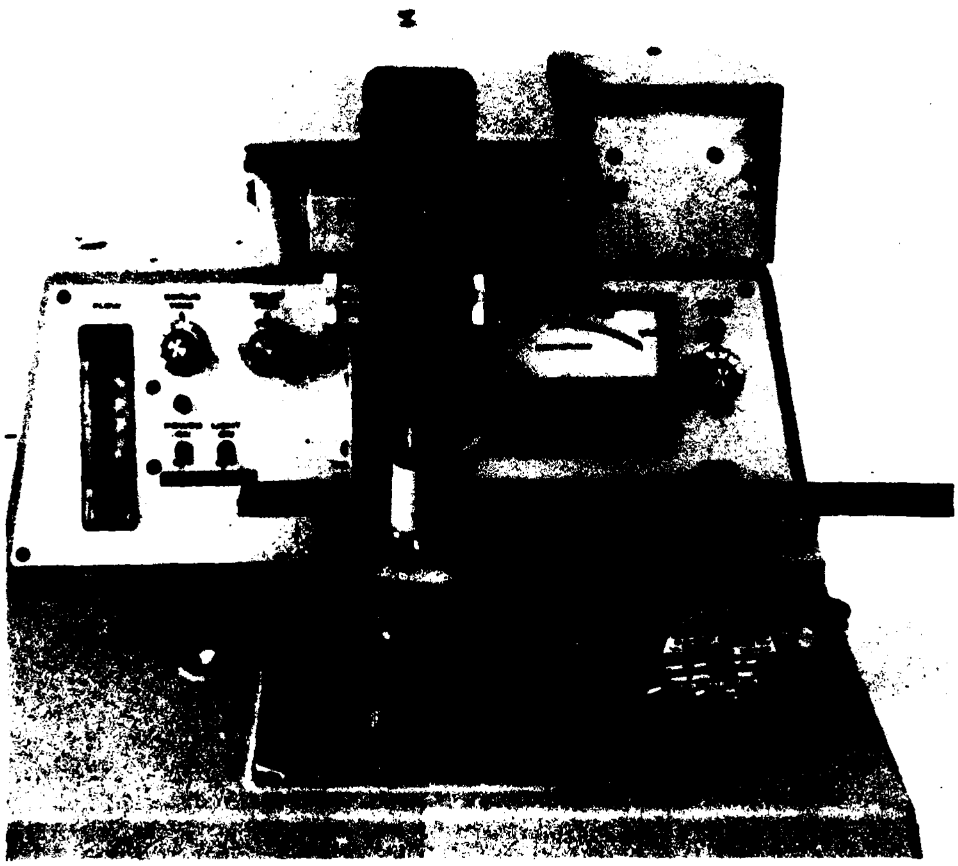


Figure 26. MEC Semiautomatic Die Bonder.

4.11 *Laurier 5A202 Epoxy Die Bonder*

The Laurier die bonder (fig. 27) is a liquid-transfer system that deposits epoxy material to attach passive or active component chips to thick film substrates. This system uses various nozzles and time-pressure adjustments to vary the epoxy dot size from 0.005 to 0.25 in. This system can dispense and place 400 to 500 chips per hour.

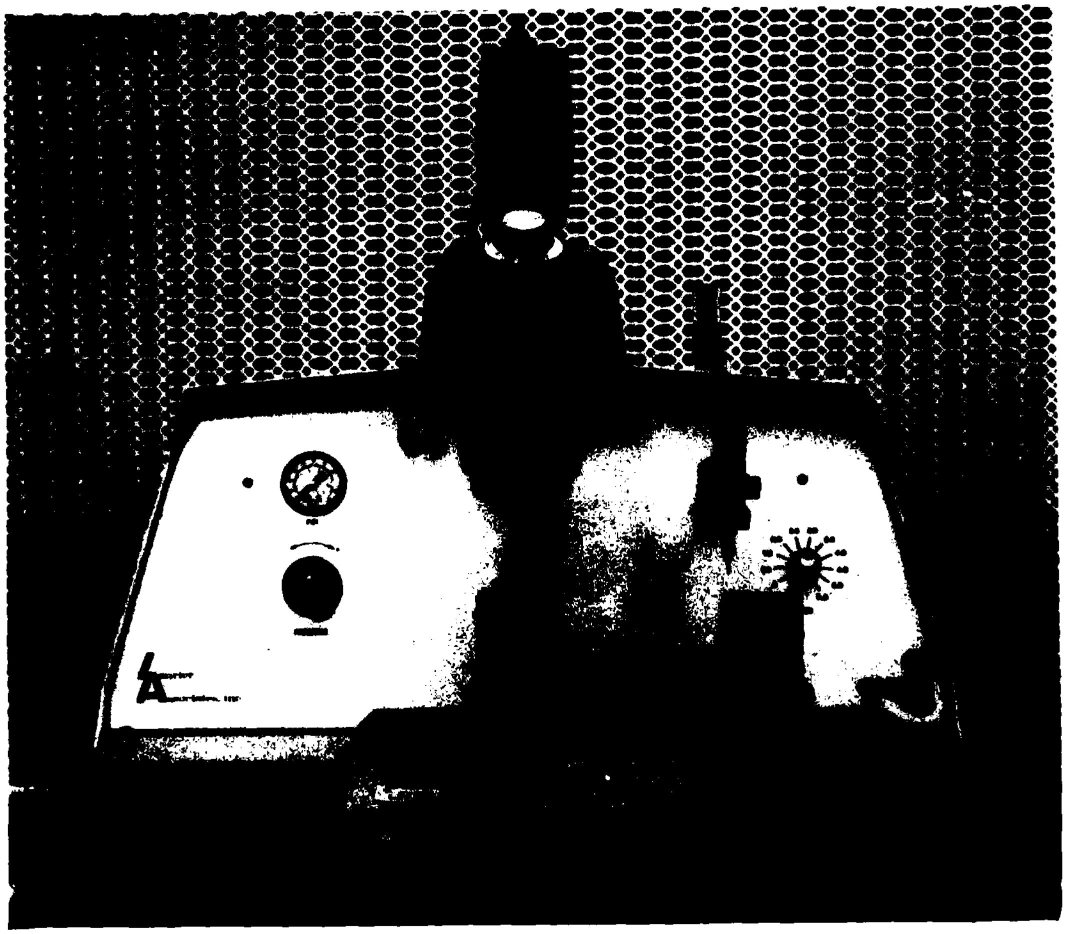


Figure 27. Laurier 5A202 Epoxy Die Bonder.

4.12 *Laurier Die Bonder*

The Laurier die bonder (fig. 28) is a liquid-transfer system that deposits epoxy material to attach passive or active component chips to thick film substrates. This system uses various square and rectangular stamps to transfer the epoxy, and then transfers the desired chip onto the newly deposited epoxy. This system can mount 400 to 600 chips per hour.

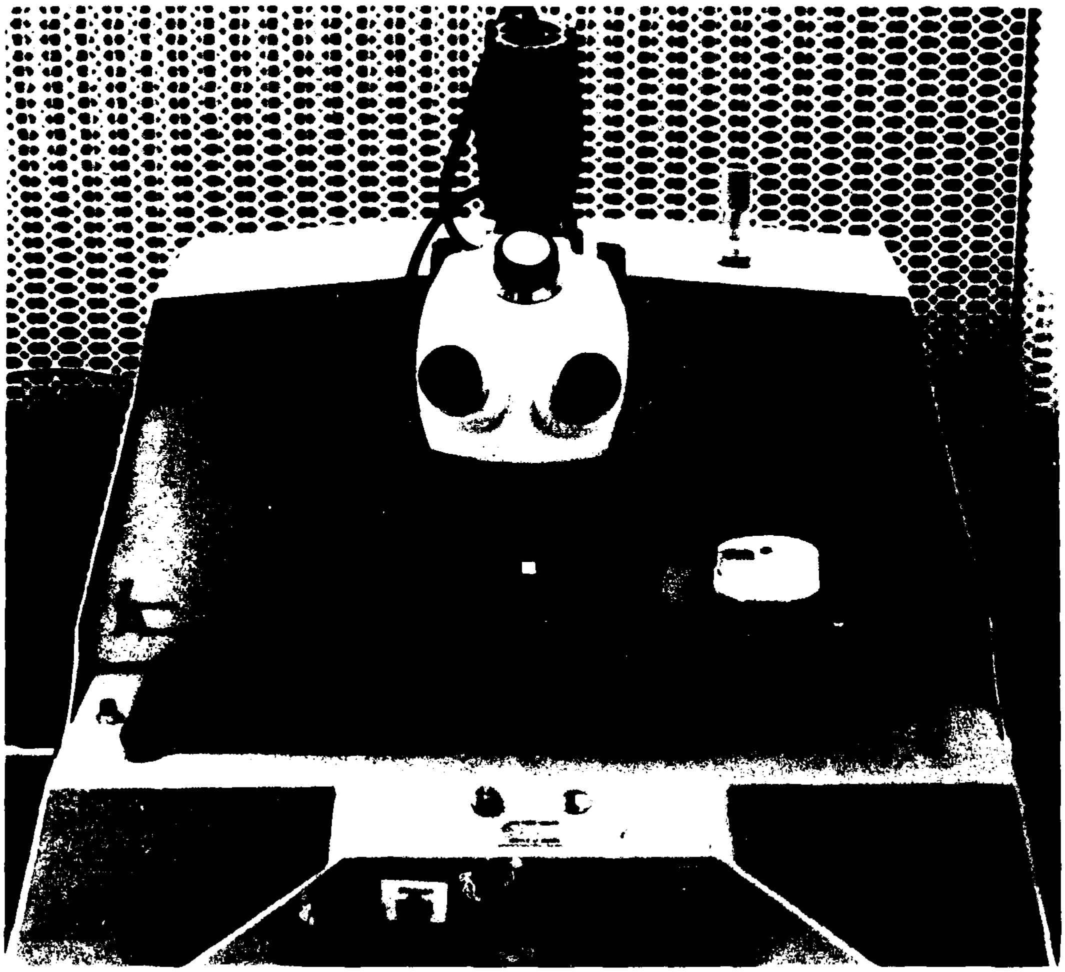


Figure 28. Laurier Die Bonder.

4.13 *K&S Model 457 Pulse Wire Bonder*

The K&S pulse tip wire bonder (fig. 29) is designed for circuits where temperatures exceeding 150° C are prohibited. This bonder uses 0.0007- to 0.002-in. gold wire for bonding hybrid components and has an adjustable tool temperature to keep heating to a minimum. The wire ball, for the nail-head bond, is formed by an electronic flameoff.

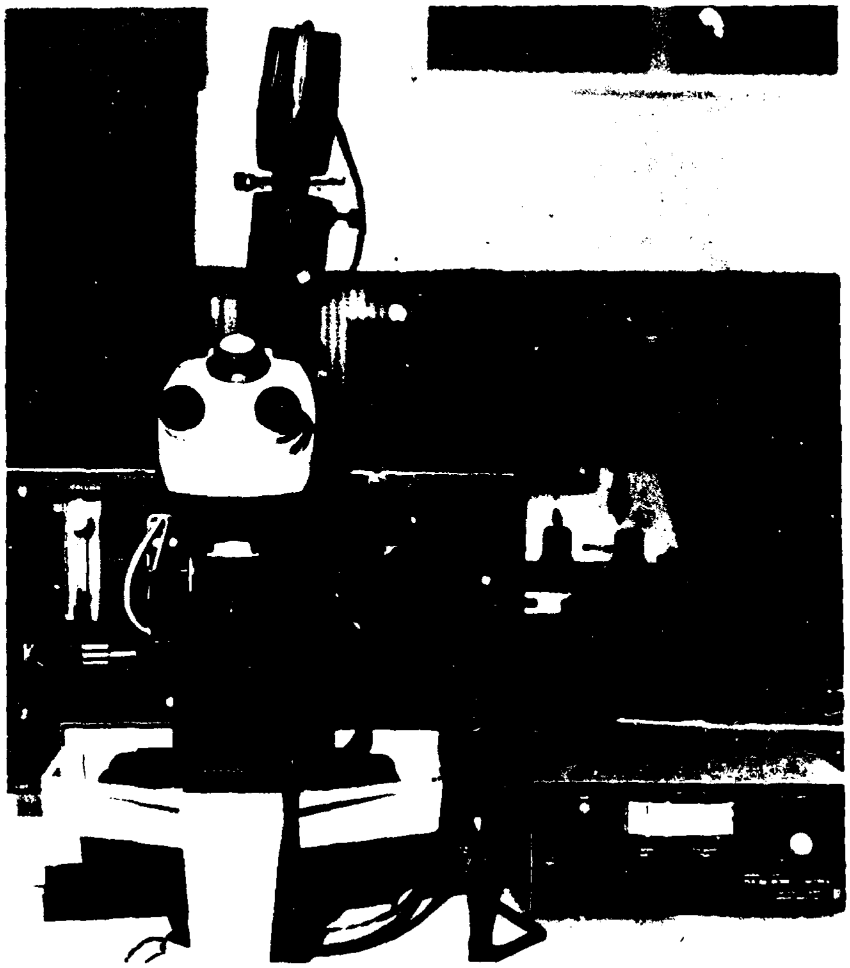


Figure 29. K&S Model 457 Pulse Wire Bonder.

4.14 *Hughes Model TCB-440 Wire Bonder*

The Hughes wire bonder (fig. 30) performs thermocompression bonding using a heated stage and capillary holder. This bonding technique combines temperature and pressure to deform and spread the bonding materials, causing a bond to be formed. This bonder uses 0.0007- to 0.002-in. gold wire to bond over an area of 1.5 by 1.5 in.

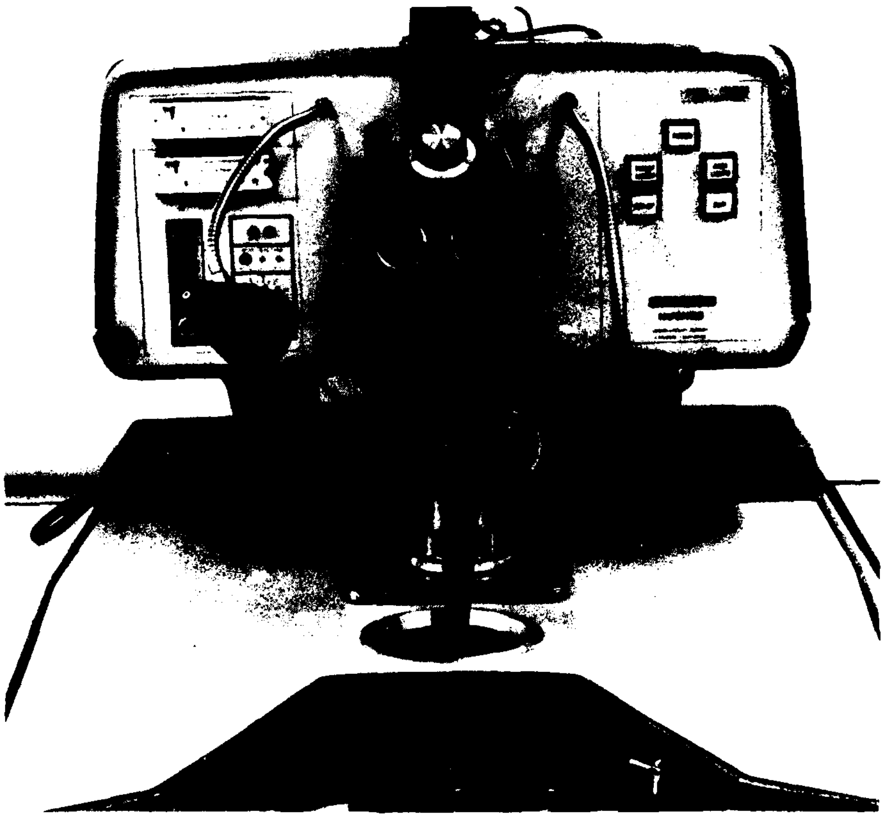


Figure 30. Hughes Model TCB-440 Wire Bonder.

4.15 *K&S Model 478 Thermocompression Wire Bonder*

The K&S bonder (fig. 31) performs thermocompression wire bonding using a heated stage and capillary holder. This bonding technique combines temperature and pressure to deform and spread the bonding materials, causing a

bond to be formed. This particular bonder offers omnidirectional bonding with solid-state controls to produce consistent high-speed operation while bonding 0.0007- to 0.002-in. gold wire.

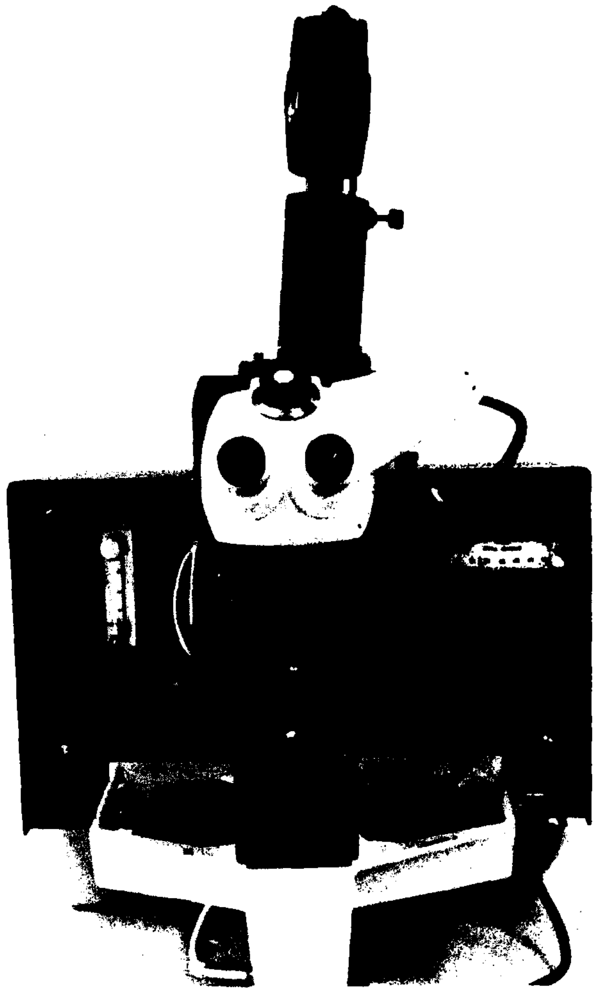


Figure 31. K&S Model 478 Thermocompression Wire Bonder.

4.16 *K&S Model 484-8 Ultrasonic Bonder*

The K&S ultrasonic bonder (fig. 32) uses an ultrasonic technique to cause scrubbing of a bond wire against the bond pad. The localized heating causes intermetallic bonding. The advantage of this bonding technique is that there is no need to heat semiconductor dies, which may be temperature sensitive. This bonder uses 0.0007- to 0.002-in. aluminum or gold wire and a wedge-shaped bond head to produce a tailless ultrasonic bond.

Figure 32. K&S Model 484-8 Ultrasonic Bonder.

4.17 *K&S Model 2402 Wire Bonder*

The K&S wire bonder (fig. 33) is characterized as a thermosonic type and features constant-tail ball bonding with electronic flameoff and solid-state controls. This bonder will bond 0.0007- to 0.002-in. gold wire onto substrates up to 2 by 2 in. with a height differential of 0.170 in. between bonds, with no stage change. This bonder is used for integrated circuit devices and most hybrid circuits.

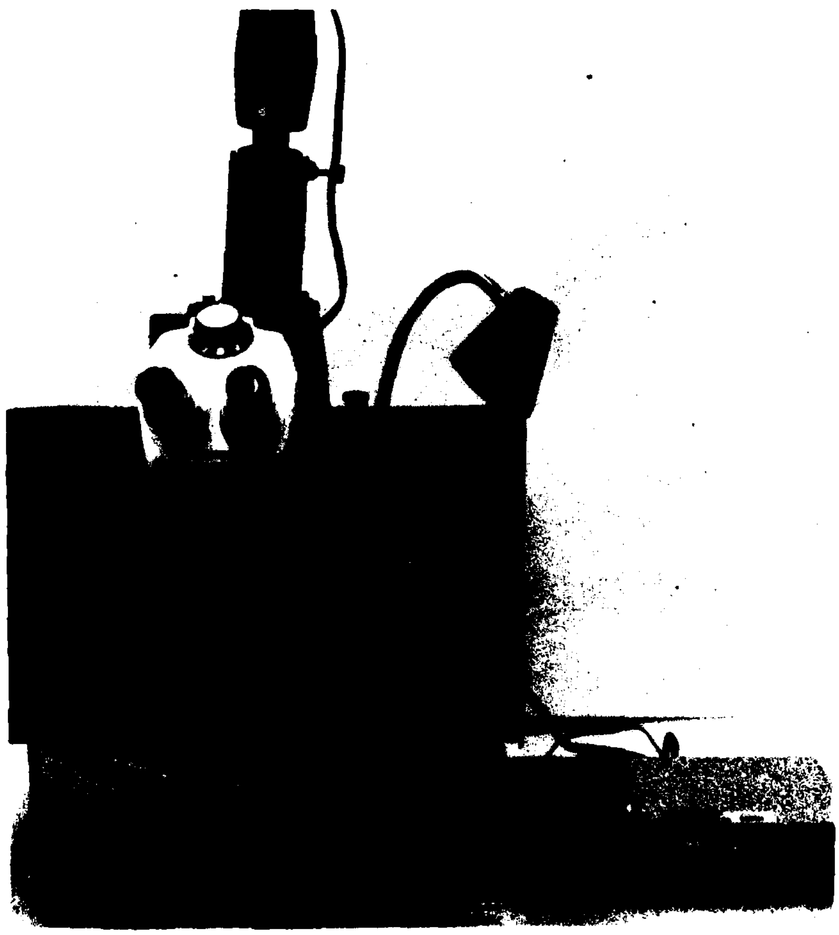


Figure 33. K&S Model 2402 Wire Bonder.

4.18 *K&S Model 1419 Automatic Bonder*

The K&S automatic thermosonic bonder (fig. 34) can bond three wires (0.0007 to 0.0020 in. in diameter) per second. It uses spotlight alignment for operator-targeted automatic operation. There is a closed-circuit TV monitor for ease of operation and a floppy disk system for the storage of programs for future use. With a usable circuit area of 4 by 2 in., this system will bond wires to large multichip hybrids.

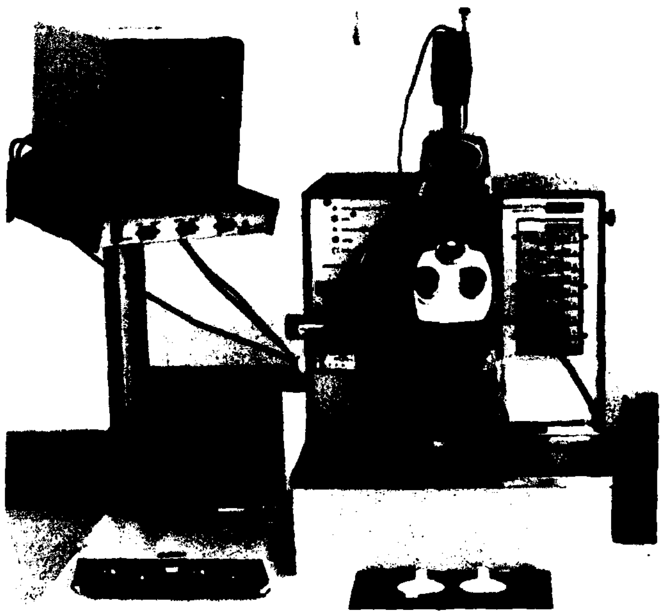


Figure 34. K&S Model 1419 Automatic Bonder.

4.19 *Engineered Technical Products Micro Pull Tester*

The pull tester (fig. 35) is used to establish the bond strength of various wire bonding systems in this facility. The bond strength is used to gauge the bonding quality of each bonder. This method of testing helps to establish the bond profile of each type of wire bonder.

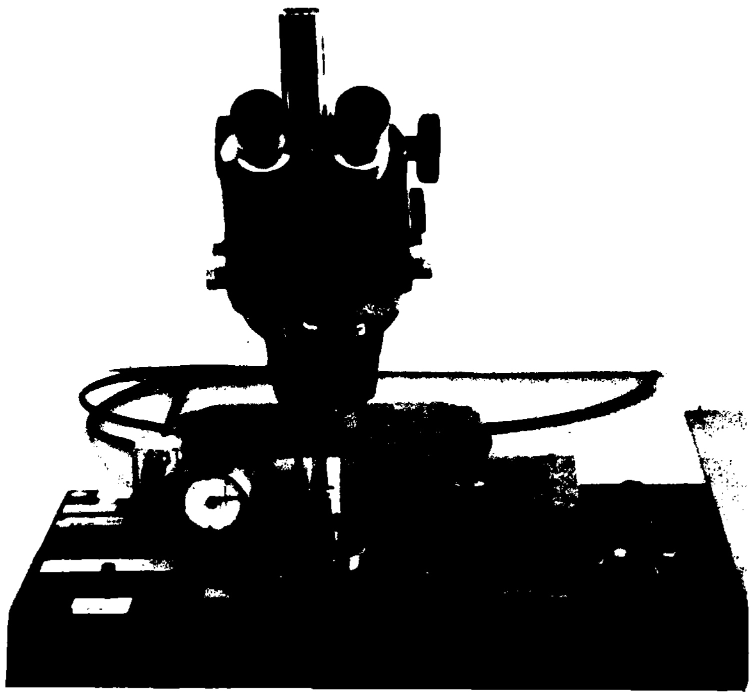


Figure 35. Engineered Technical Products Micro Pull Tester.

4.20 *Union Carbide Parylene Coating System*

The parylene coating system (fig. 36) is used to deposit a thin layer (0.0001 to 0.0015 in.) of parylene onto electronic circuits, modules, and so on. Parylene is a tightly adhering organic film used as a corrosion-resistant conformal coating. Parlyene has excellent dielectric properties with the additional benefit that it coats and anchors any debris that could remain on the module. In doing so, it diminishes the chance of intermittent shorts that might otherwise occur because of moving debris. Parylene has a major secondary advantage, since, in coating wire bonds, this film strengthens the bond and deters breakage.

4.21 *Superior Package Welding System*

Microelectronics fabricated in the thick film facility must often meet stringent packaging requirements. To meet these needs, a package sealing system is available. This system (fig. 37) hermetically seals round or rectangular

packages (0.375 to 2 in.) in a controlled atmosphere at the maximum rate of 200 spot welds per minute. This system uses a moisture monitor and vacuum-drying oven to regulate and condition the weld environment.

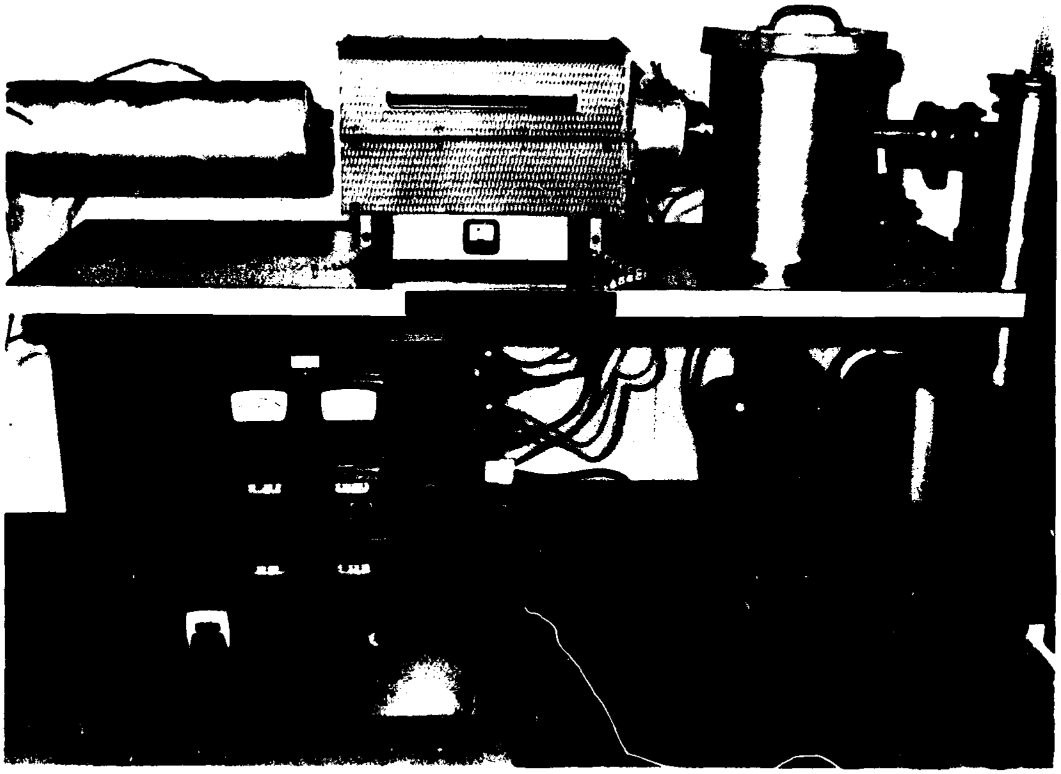


Figure 36. Union Carbide Parylene Coating System.

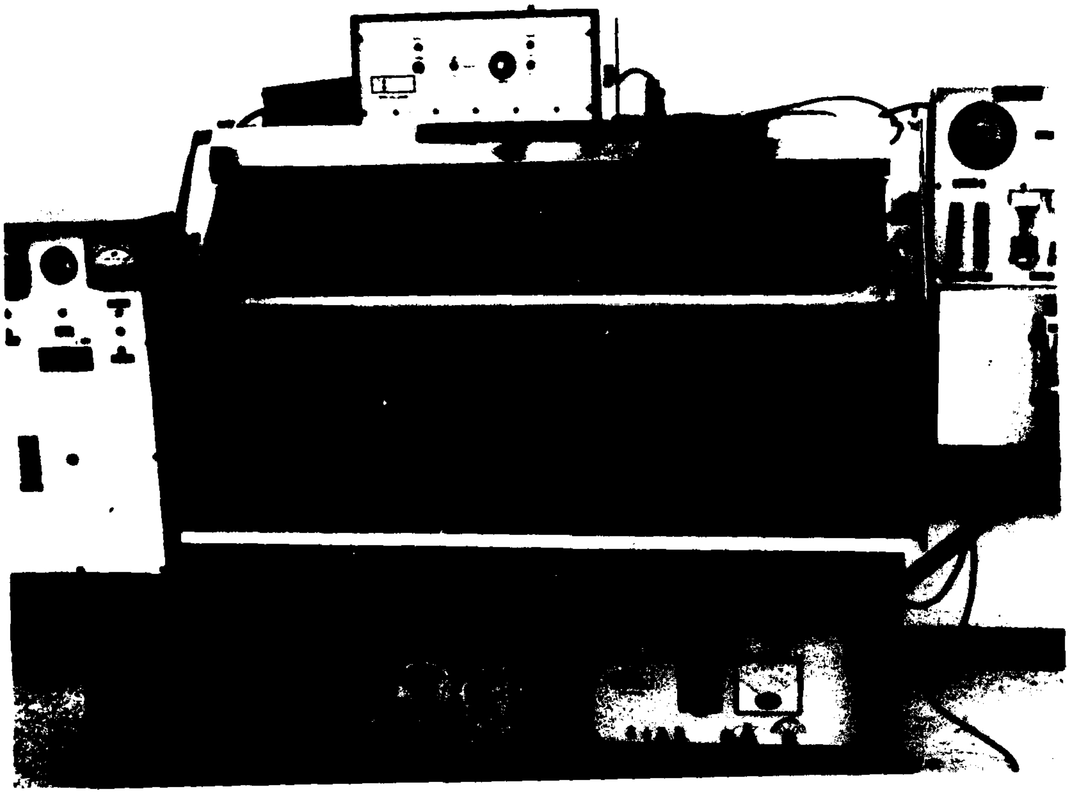


Figure 37. Superior Package Welding System.

5. ASSEMBLY/MODEL SHOP

The Prototype Support Section fabricates small quantities of experimental ordnance electronic equipment (fig. 38). Quantities range from single breadboard circuits to complete fuze assemblies in the thousands.

As part of the assembly capabilities, specific workmanship standards must be maintained. Most of these standards are set by Military Standards for high-reliability soldering and assembly of electronics for conventional weapons systems.

To give an idea of the diversified capabilities of this section, a description of some of the more significant manufacturing and assembly machines follows.

Figure 38. Assembly/Model Shop.

5.1 *Ragen Model 750 Assembly System*

The Ragen assembly system (fig. 39) automatically locates and selects up to 75 different components for PC board insertion. The system consists of a projected light arrow, computer-controlled component tray selector, and programmer control box. The machine must be programmed before it performs the continuous PC assembly. Programming consists of copying a master board which contains all the inserted parts in their correct orientation. The system programming module is used to copy the location and orientation of every part on the master board into system memory. Along with each part, a tray (one of 75) is assigned.

During operation, an "unstuffed" board is precisely located within the supporting framework, and then parts are inserted in the same order as the copied parts on the master board. This process offers the advantage of high-speed parts insertion that requires a minimum of operator training.

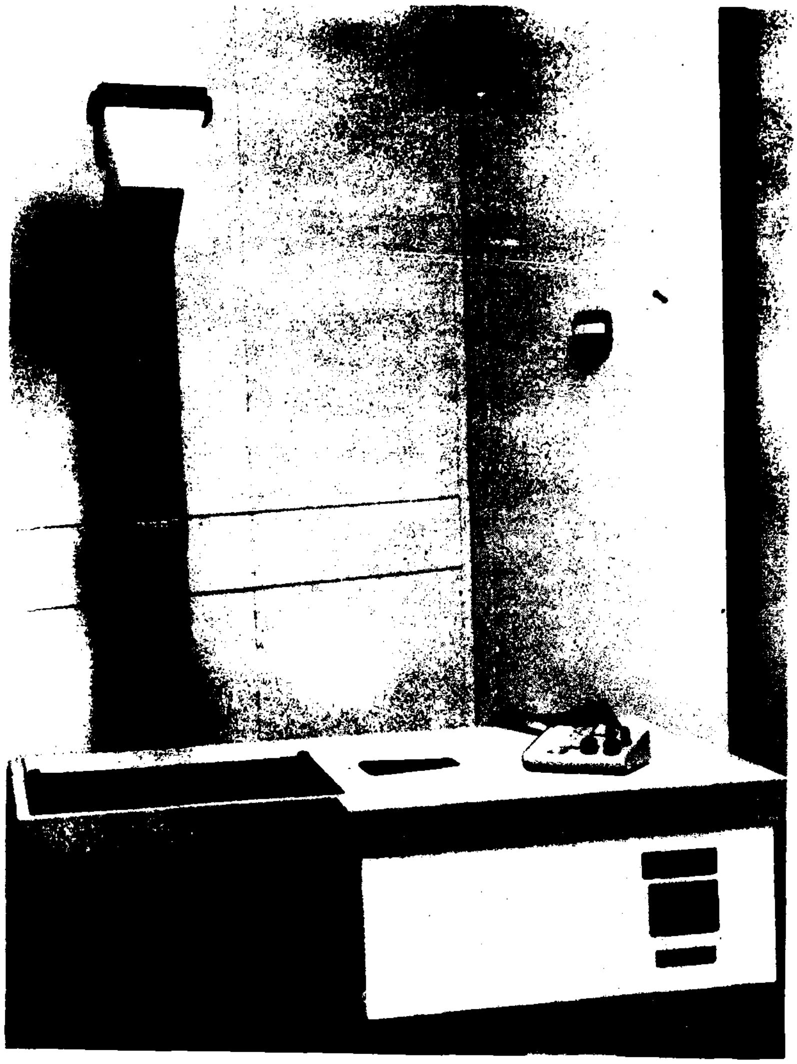


Figure 39. Ragen Model 750 Assembly System.

5.2 *Hollis Wave Soldering Machine*

The Hollis wave soldering machine (fig. 40) is used to solder PC board assemblies containing precleaned components. The boards are rack mounted on a chain-drive conveyor which passes through a foam fluxer and a preheat area, and over a 6-in. wide solder wave. The entire soldering process yields extremely repeatable results for high-volume soldering requirements.

Figure 40. Hollis Wave Soldering Machine.

5.3 *Gardner-Denver SP29 Computer-Aided Wire-Wrap Machine*

The Gardner-Denver SP29 (fig. 41) is a tape-controlled semiautomatic wire-wrap system. The system consists of a tape reader, a wire stripper, and a pointer. Following paper-tape instructions, this system can locate up to 500 posts for operator-performed wire-wrapping. The machine can handle wire-wrap panels up to 26 by 42 in. and repeatably locate wiring points with 0.005-in. accuracy.

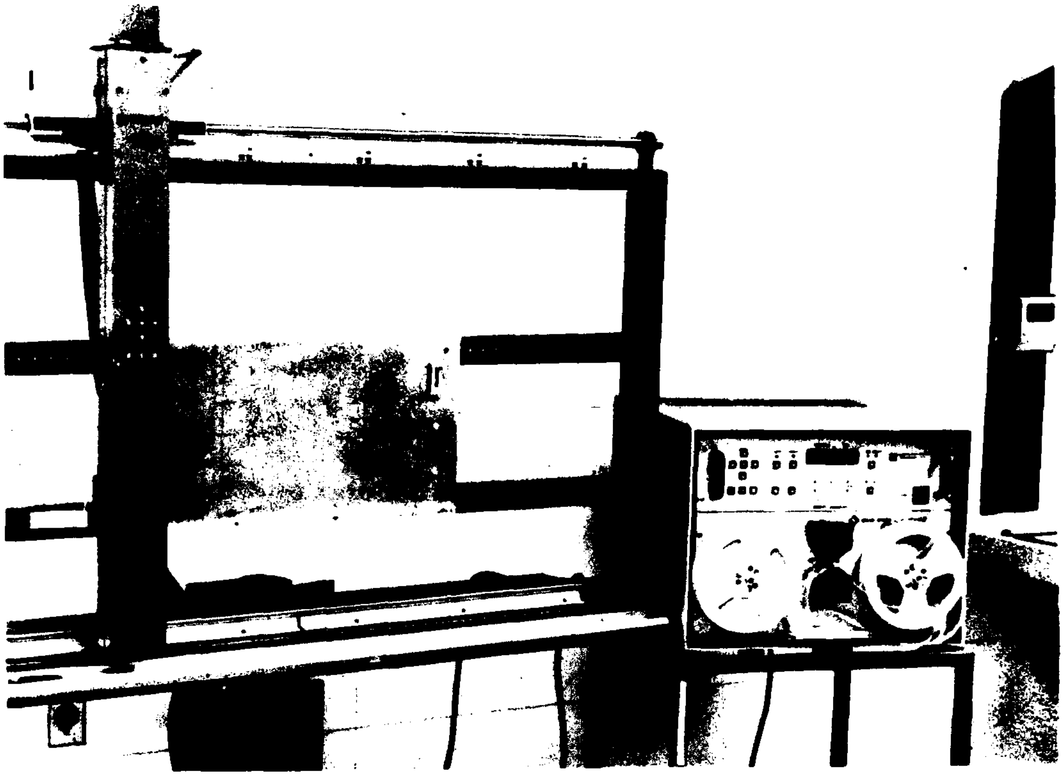


Figure 41. Gardner-Denver SP29 Computer-Aided Wire-Wrap Machine.

5.4 *Martin-Sweets Foam Potting Machine*

The Martin-Sweets foam mixing machine (fig. 42) is used to blend a variety of foams of varying densities for encapsulation of electronic assemblies. The primary material density usage is 6 through 24 lb/ft^3 of urethane foam. The dispensing mechanism is controllable to dispense a wide range of volumes to accommodate large cavities as well as small microelectronic volumes.

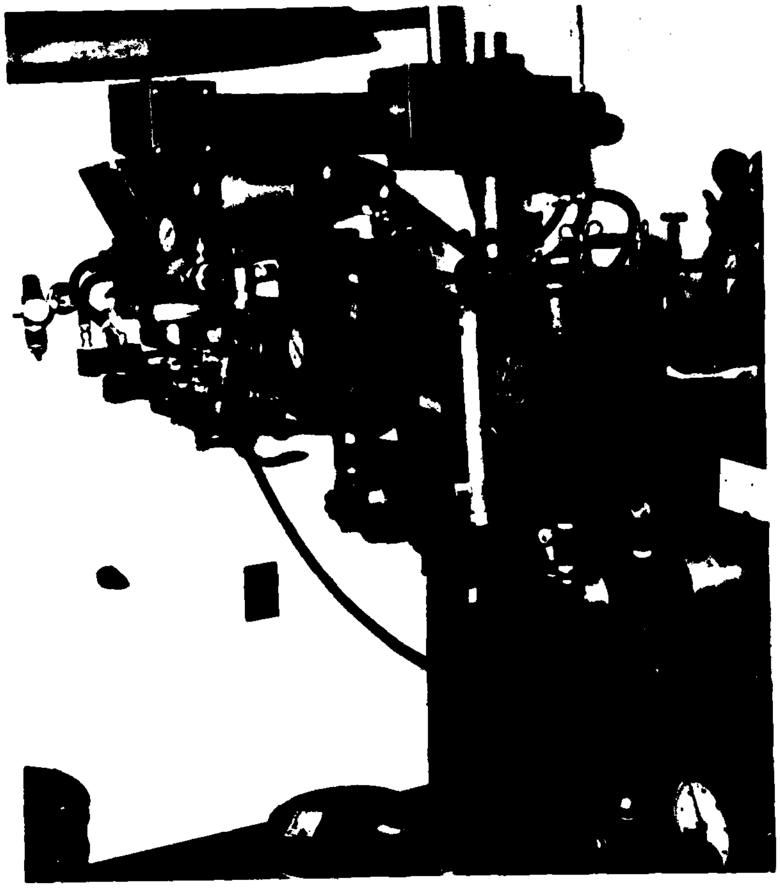


Figure 42. Martin-Sweets Foam Potting Machine.

5.5 *Hewlett-Packard (HP) Model 9500D Computer-Controlled Testing System*

The HP test system (fig. 43) is used to test a variety of electronic components and assemblies. The tester can make both analog and digital measurements and is composed of the following test modules:

- minicomputer
- cartridge disk memory

- cathode ray tube terminal
- printer
- control panel
- a set of electronic stimuli
- electrical measurement equipment

The electronic stimuli set consists of a frequency synthesizer, pulse generator, and three power supplies. A digital tester is incorporated into this computer-controlled tester.

The measurement set consists of a digital multimeter, a counter-timer, and a waveform processor.

The stimuli and measurement sets are both under computer control; with the use of a complex modular switch matrix, a wide variety of tests can be easily accomplished with accurate repeatable results.

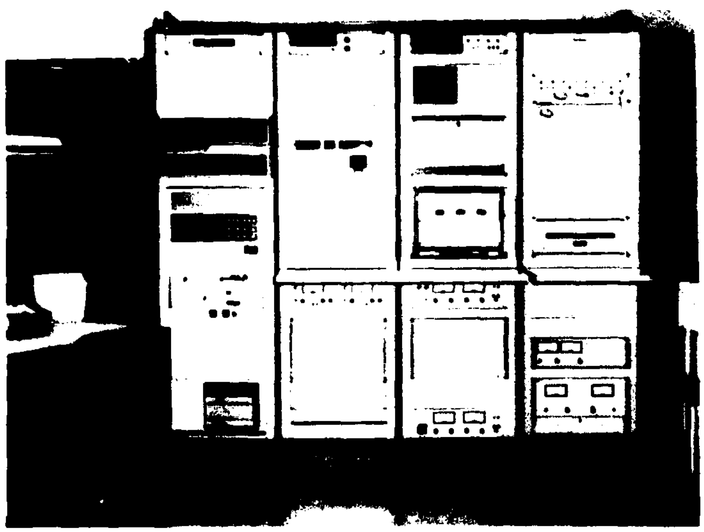


Figure 43. Hewlett-Packard (HP) Model 9500D Computer-Controlled Testing System.

6. COMPONENT TESTING AND EVALUATION

The component testing and evaluation facility evaluates components to determine whether the component structure and electrical parameters can be maintained under high-stress environments. Methods used to qualify parts include air-gun testing and a 57-mm gun firing. These gun tests provide controlled shock environments to a wide range of components; as part of "qualification," components may be gun-tested over various temperatures. Any failure of a qualified component is immediately investigated to determine the mode of failure and to locate a qualified substitute.

7. AVAILABILITY FOR ELECTRONIC SUPPORT

This entire facility is available to support prototype electronic assembly/manufacturing requirements of any Government agency. Availability, for agencies outside HDL, is on a first-come, first-served basis. For additional information on how this facility can meet advanced electronic assembly/manufacturing requirements, contact:

Joseph L. Ansell
Chief, Electronic Technology Branch
Phone: (202) 394-2840, AV 290-2840

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